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Distribution of Submersed Vascular Plants Chesapeake Bay, Maryland

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DISTRIBUTION OF SUBMERSED VASCULAR PLANTS, CHESAPEAKE BAY, MARYLAND

by

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This research attempts to determine past and current (1978) distribution of submerged aquatic vegetation in Chesapeake Bay Maryland and to formulate recommendations for future surveys with regard to frequency and methologdy. Current distribution of SAV was determined through interpretation of black and white aerial photographs, field work in selected areas was conducted through use of seaplane, distribution of SAV was mapped on 1:24,000 U.S. Geological survey Topographic map. A total of 77 maps were produced. Past distribution of SAV was determined through interpretation or archival photographs. Distributional changes from 1936 to 1978 were plotted for three areas in the upper Bay.

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U.S. ENVIRONMENTAL PROTECTION AGENCY

CHESAPEAKE BAY PROGRAM

In response to Congressional directive, the U.S. Environmental Protection Agency established the Chesapeake Bay Program (CBP) to conduct an in-depth study of the Chesapeake Bay and its resources. The Program was initiated in 1976 as a five-year, $25,000,000 program to conduct interdependent scientific and management investigations addressing the environmental quality of the Chesapeake Bay. Major responsibilities are defined as follows:

- to assess the principal factors having adverse environmental impact,
- to direct and coordinate research and abatement programs,
- to collect research data and institute a monitoring program, and
- to define Bay management structures

Within EPA, the Chesapeake Bay Program is a coordinated effort between the Office of Research and Development and the Mid-Atlantic Region III Office and is administered from a field station in Annapolis, Maryland.

Initial CBP efforts established strong working relationships with the Bay area States, the scientific community and the citizenry. The Program involves active participation from Maryland, Virginia, Pennsylvania and Bay region citizens.

Programs are underway to research toxic substances, submerged aquatic vegetation (SAV), eutrophication (excessive enrichment), and environmental management. To support all Program efforts, including the interpretation of data, computer modeling, and long-term data storage and retrieval a data management system capable of meeting CBP needs is being developed.

The products of the four program areas will provide important tools aiding in defining management alternatives to improve the environmental quality of the Chesapeake Bay. Citizens, managers, scientists and Bay users will all input to the development of alternative control strategies. The coordinated efforts of the Chesapeake Bay Program provides a foundation of interdependent scientific and management criterion important to managing the environmental health of the Chesapeake Bay.

FORWARD

Submersed aquatic vegetation (SAV) is now recognized as an integral part of the functioning of a healthy Chesapeake Bay system. The dependence of many water oriented animals on SAV for life support activities is now well documented.

Recent indications of dramatic decline in SAV distribution is of concern to all who appreciate the Chesapeake Bay as a unique and valuable resource. The EPA Chesapeake Bay Program has initiated several studies of SAV in the Bay to better understand trends in distribution and abundance, ecological requirements and effect of toxic substances on growth and reproduction.

This effort, in combination with that being conducted for the State of Virginia, provides the first comprehensive inventory of SAV over the entire Chesapeake Bay. The products of this study, a series of 77 distribution maps, will provide baseline information for future management programs and methodologies for future surveys.

ABSTRACT

This research was initiated with the overall objectives of determining past and current (1978) distribution of submersed aquatic vegetation (SAV) in the Chesapeake Bay, Maryland and to formulate recommendations for future surveys with regard to frequency and methodology.

Current distribution of SAV was determined through interpretation of 1:24,000 scale black-and-white photographs procured during the growing season. Field work was conducted in all areas with the use of a seaplane. Distribution of SAV was mapped on 1:24,000 U.S. Geological Survey (U.S.G.S.) topographic map mylars. A total of 77 maps were produced. A photo-copy of each map is included in this report. The minimum mappable bed size was approximately 0.25 hectares. There were 16 quad sheets with no mappable vegetation present and 24 sheets that had less than 10 hectares of vegetation. Of the 40 sheets with less than 10 hectares of vegetation, 11 were north of the Chester/Magothy Rivers and 21 were south of the Choptank/Upper Patuxent Rivers to Smith Island on the eastern shore. This would indicate that the mid-portions of the Chesapeake Bay were relatively healthy with regard to distribution of submersed vegetation. This area of the Bay also contained the highest diversity of submersed vegetation.

Diversity declined rapidly from eight to two to three species in the southern portion of the Eastern Shore where *Zannichellia palustris* and *Ruppia maritima* predominated. There were only a few small areas of *Zostera marina* found in the lower Bay, those being in the south marsh island area.

Past distribution of SAV was determined through interpretation of archival photographs of varying scale and type. Distribution from 1952 to 1978 for various dates within that time period was plotted for three areas in the upper Bay. These sites encompassed the Chester River area, the Eastern Bay area and one site on the western shore to include Salt Peter and Seneca Creeks.

The Eastern Bay site had the least useable photography and the Chester River site the most. Trends in the Chester River area indicate fluctuation in distribution with time. The "bloom" and consequent decline of *Myriophyllum spicatum* over the whole Bay may have accounted for some of this fluctuation. There was a decline in the 1972 data which may show the effects of a hurricane during June. There was an encouraging increase in distribution shown in the 1978 survey.

The Eastern Bay area site had very little data available for ascertaining distribution. There does appear to be a downward trend from 1970 to 1978. The Salt Peter/Seneca Creek area site was selected due to the presence of a thermal power generating station which discharges heated water into Salt Peter Creek. Operation began in 1962. SAV distribition data prior to 1960 and after beginning of operations (1964) indicate a relatively stable situation. This was, however, the time of *Myriophylum* "blooms" and may mask the absence of other more thermally sensitive species. There also appears to be a slight downward trend in distribution from 1970-1978.

Recommendations for future SAV surveys include larger scale color photography in areas defined as "critical" in order to better define species association and a frequency of at least once every three years.

This report was submitted in fulfillment of Grant No. R 805977-01-0 by The American University under sponsorship of the U.S. Environmental Protection Agency, and covers the period June 1, 1978 to January 31, 1980. Work was completed as of September 30, 1979.

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SECTION 1

INTRODUCTION

Interest in the distribution and abundance of submersed aquatic vegetation (SAV) in the Chesapeake Bay has been steadily growing since the late 1950's. Parallel to increased awareness of the value of emergent wetlands, the value of the submersed vegetation has now been recognized in the Bay ecosystem. In the last 20 years, the possible value of SAV beds has been recognized, and the need for further research of their apparent population dynamics to provide orderly management of this resource has been identified.

As primary producers, submersed vegetation represents an important part of the first trophic level in the Bay's aquatic ecosystem. Most of the above-ground biomass decomposes annually to detrital food particles available to herbivores. The dependence of the crabbing and fishing industries upon the nursery and shelter functions provided by the SAV beds is now better understood. The value of SAV as a food source to waterfowl has been recognized for the past 20 years.

Submersed aquatic vegetation is an integral part of the Bay ecosystem in that:

- SAV constitutes the principal source of food for waterfowl and some herbivorous fish species.
- SAV provides nursery areas and shelter from predation at various growth stages for many species of fish and crabs.
- SAV provides habitat for epifaunal and infaunal species of copepods and mollusks that are an important food source for waterfowl and fish.
- SAV, as a primary producer of vegetative biomass, contributes nearly all of its above-ground standing crop annually to the detrital food chain.
- SAV serves a wave-damping function, reducing shoreline erosion and allowing settling of sediments.
- SAV plays an oxygenation role in the aquatic ecosystem.

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BACKGROUND

Submersed Vegetation in the Chesapeake Bay

Historic documentation of the distribution and abundance of aquatic vegetation in the Chesapeake Bay is sparse prior to the late 1950's. The first comprehensive survey of SAV was begun in 1958 by the U.S. Fish and Wildlife Service's Migratory Bird Habitat Research Laboratory (MBHRL) on the Susquehanna Flats and has continued until the present. The relative abundance of the major species was monitored at random stations. Where established boat transects intersected SAV beds, plants were rated as abundant, common, occasional, or rare based upon visual observations of grab samples every 275 to 366 m. The total annual percent cover was impossible to estimate but is believed to have generally declined reaching an all time low in 1972. Percent cover estimates within beds were not possible with this methodology.

In 1959-1961, Stotts (1960) established nine transects across the Bay between the Susquehanna Flats and South Marsh Island and took Peterson dredge samples of SAV and benthos for correlation with waterfowl counts. The number of samples that could be taken using this methodology were insufficient due to the extreme variation of SAV bed locations within the Bay. The study was abandoned after the third year with no conclusive SAV/waterfowl correlations.

In 1967-1969, Stotts (1970) established a pilot study to determine which methods would be necessary to develop a system that could determine variations in distribution and abundance of SAV. It took 3 successive years and over 1,000 transects to survey the area from the Virginia/Maryland boundary north to the Elk River. Drag records rated SAV species as abundant, common, occasional, or rare. SAV abundance seemed to be greater in the southerly, more brackish embayments, and the fresher water Bay shores, with bed density greatest in waters 0.3 to 2.0 m deep. Records were kept of percentage transects vegetated for each species. From 1971 to 1978, the MBHRL and the Maryland Department of Natural Resources (Kerwin et al., 1975; Munro 1976) have made annual visits to 650 sample stations in response to the need for a data base on SAV in the Chesapeake Bay. Observations at each station included the presence or absence of SAV and the percent composition by species from visual observations where SAV was found. Data from 47 stations in Eastern Bay and 36 stations in Chester River showed 6 year averages of 35 percent and 28 percent of the stations vegetated, with ranges of 25 percent and 15 percent, respectively. Based upon these figures, annual fluctuations of total vegetation may be 7.5 and 12.5 percent.

There has been concern about the rooted vascular aquatic plants in the Patuxent River since 1964, prior to the installation of a thermal power generating station at Chalk Point. Anderson (1969) conducted quantitative and qualitative studies of rooted aquatics in the area with the following results:

a. Six rooted vascular plants were common in this portion of the river. These were: *Ruppia maritima*, *Potamogeton perfoliatus*, *Myriophyllum spicatum*, *Najas flexilis*, *Elodea canadensis*, *Zannichellia palustris*.

b. *Ruppia maritima* declined in the immediate area of Chalk Point, following startup of the power generating station.

c. *Potamogeton perfoliatus* increased in areal extent following startup of the power generating station, invading some areas previously occupied by *Ruppia maritima*.

As part of the study, a generalized map of rooted aquatic vegetation between Summerville Creek and Sheridan Point was produced. This is the only map which exists of the rooted aquatic vegetation in the area potentially affected by the thermal plume from the power generating station.

Anderson (1970) also reported on SAV distribution in Chincoteague Bay, Maryland, which has pertinence to the Chesapeake Bay. Stevenson and Confer (1978) in a very useful document summarized available information on Chesapeake Bay submersed vegetation. Bayley et al. (1978) reported on changes in SAV populations at the head of Chesapeake Bay from 1958-1975.

Use of Aerial Photography to Assess Distribution and Abundance of Submersed Vegetation

Aerial photography has been used by several investigators to estimate distribution of submersed vegetation along shorelines. Anderson (1969) was apparently the first to use aerial photography for this purpose in the Chesapeake Bay. Lukens (1968) was also an early contributor on this subject. Orth (1975) used this technique to study eelgrass beds in the lower Bay. Markham (1977) mapped submersed vegetation from aerial photos in Canadarago Lake, New York. Good et al. (1978) reported on work in New Jersey.

Macomber (1979) conducted research to determine the optimal film filter combination from mapping SAV plants. During mid-August of 1977, various scales of multispectral photography were flown in the Eastern Bay and Eastern Neck regions of the Bay. The results of analysis and controlled compositing of various band combinations were that the best single band was the red band. The near-infrared band offered no water penetration and thus no SAV information. The blue band was severely degraded by atmospheric haze (particularly at altitudes of 3,660 m (12,000 ft. and higher) and by water turbidity. Combinations including the blue band added nothing at the lower altitudes and degraded the imagery at the higher altitudes. The green band provided slightly less depth penetration than the red band but offered a contribution. Thus, a red/green band combination was determined to be the optimal sensor package.

SECTION 2

CONCLUSIONS

The results of this project indicate that a broad distributional survey of SAV can be conducted within a relatively short period of time if the proper tools of aerial photography and seaplane ground truth reconnaissance are available. The black-and-white 1:24,000 scale photography was adequate for bed delineation except in a very few areas with severe water turbidity. Seaplane data collection was necessary in these areas. Localized turbidity and the bimodal onset of growth and decline for *Zannichellia palustris* and *Ruppia maritima* indicated a requirement for two photo flights if total distribution of SAV is to be obtained. Two flights, one early (June) for *Zannichellia palustris* and one late (August-September) for *Ruppia maritima* would be required to fully define seasonal changes in SAV distribution.

The following conclusions can be made regarding the distribution of SAV throughout the Maryland portion of the Chesapeake Bay.

- There are regions that have very low distribution in relation to available habitat. These include the western shore from Baltimore Harbor to Susquehanna Flats; the eastern shore from the Elk River south to above the Chester River; the Patuxent River; the lower Potomac River.

- There are regions that appear to be relatively healthy with regard to species distribution and species diversity. These are the Chester River and Eastern Bay.

- There are regions which may be considered to be marginal in distribution. A frequent monitoring program should be established to follow trends in distribution. These areas are the western shore from Baltimore Harbor south to Herring Bay; the Choptank River system; and the lower eastern shore from the Honga River to Smith Island.

- The apparent decline in distribution of *Zostera marina* in the lower eastern shore region of the Maryland portion of the Bay should be of concern. Very little of this species was found during the 1978 survey.

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- The Maryland Department of Natural Resources yearly distributional trend surveys compare well with our technique when their sample stations are overlayed with the distribution maps produced in this project. These trend studies would benefit from the use of a seaplane and should continue on a yearly basis. If overall SAV bed distribution trends are desirable, the aerial photographic technique combined with seaplane confirmations is superior to ground surveys and should be conducted at least every three years.

The results of the intensive study area indicate that color photography at a scale of 1:6,000 is adequate for delineation of percent cover class and species association information within individual SAV beds. Management maps at this larger scale would allow relative value assessment of beds within or between watersheds, offer input to dredge spoil deposition impact assessments, and assist in identifying areas where replanting to control erosion may be fruitful.

The results of the archival photographic study indicate that, where available, and if suitable, these data can be used to map gross distribution of SAV. In many instances, however, data in the proper season were missing and left gaps in the record. The photographic record was most complete from 1950 to the present. Trends in two area studies, one on the western shore and one on the eastern shore, indicate rather large fluctuations during this period, particularly coinciding with the eurasian water milfoil influx in the 1960's. These fluctuations may be due to poorly timed photography which cannot be confirmed due to the lack of field data during that time period.

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SECTION 3

RECOMMENDATIONS

Based upon the conclusions of this project, we would propose the following as research that is needed regarding the distribution of SAV in the Chesapeake Bay:

1. A broad survey such as the one just completed should be systematically conducted, utilizing aerial photography in concert with seaplane ground truth, the frequency of which is difficult to ascertain. A three year cycle would probably document trends. There is need to conduct some type of boat and/or seaplane sampling survey on a yearly basis at this time due to a lack of understanding of the annual fluctations of SAV growth. Carefully selected stratified sampling sites based on the distribution maps now available could alleviate the need for annual baywide surveys. Small format aerial photo documentation of sample sites from a seaplane would complement biomass data collected by landing at each site.

2. If total SAV distribution is needed, two high altitude photo flights will be required due to localized turbidity and the varying growth stages of Zannichellia palustris and Ruppia maritima.

3. A system should be devised to choose regionally representative and/or high value areas where SAV distribution could be monitored more closely. Information on species composition, percent cover, biomass and seasonal growth characteristics would provide needed management information.

4. There is a need for a combined laboratory and field study to investigate the environmental parameters of light and temperature, at a number of locations, to ascertain critical ranges of these variables for optimum SAV growth and reproduction.

SECTION 4

MATERIALS AND METHODS

AERIAL PHOTOGRAPHY

Entire Project Area

The project area encompassed the Maryland portion of the Chesapeake Bay and the lower portions of all tributaries. Figure 1 shows the boundaries of the area and locations of U.S.G.S. topographic quadrangles utilized for SAV mapping purposes.

The aircraft used to acquire photography was a Cessna 180H STOL with an aerial mapping, center line camera port operated by AeroEco of Reston, Virginia. It was equipped with a Wild RC-5A metric mapping camera with a 9 x 9 inch format and a six inch focal length lens. Full tilt and crab corrections are a standard feature of this camera, as are automatic 60 percent stereo overlap and integral view finder flightline tracking. The camera holds a recent (January 1978) certification and calibration report by the United States Geological Survey in Reston, Virginia. The aerial film utilized was Kodak Double-X Aerographic 2405 with a minus blue filter. This film has a flat spectral sensitivity in the red where maximum haze penetration is possible and SAV information is found.

The resolving power of Double-X 2405 is 100 lines/mm for a high contrast object and 50 lines/mm for a low contrast object such as SAV. It has an effective aerial film speed of 320 versus Aerochrome MS of 32, i.e., a factor of 10 greater film speed. With 2405, the Kodak Aerial Exposure Computer indicated that proper exposure was possible with the maximum aerial camera aperture of f-5.6 and a shutter speed of 1/350 of a second at solar altitudes down to 3 degrees at 3,048 m (10,000 ft.).

The nominal scale of the aerial photography was chosen to match the quad sheet mapping base, i.e., 1:24,000. This required a flying height of 3,658 m (12,000 ft.) AGL and provided a ground coverage of 5,486 m (18,000 ft.) on a side per photograph. With standard stereo forward lap and side lap and an east/west flightline orientation, 12 photographs were required to cover a full quadrangle sheet.

Table 1 shows the general guidelines followed for acquisition of photography. A typical day when photography was obtained began with

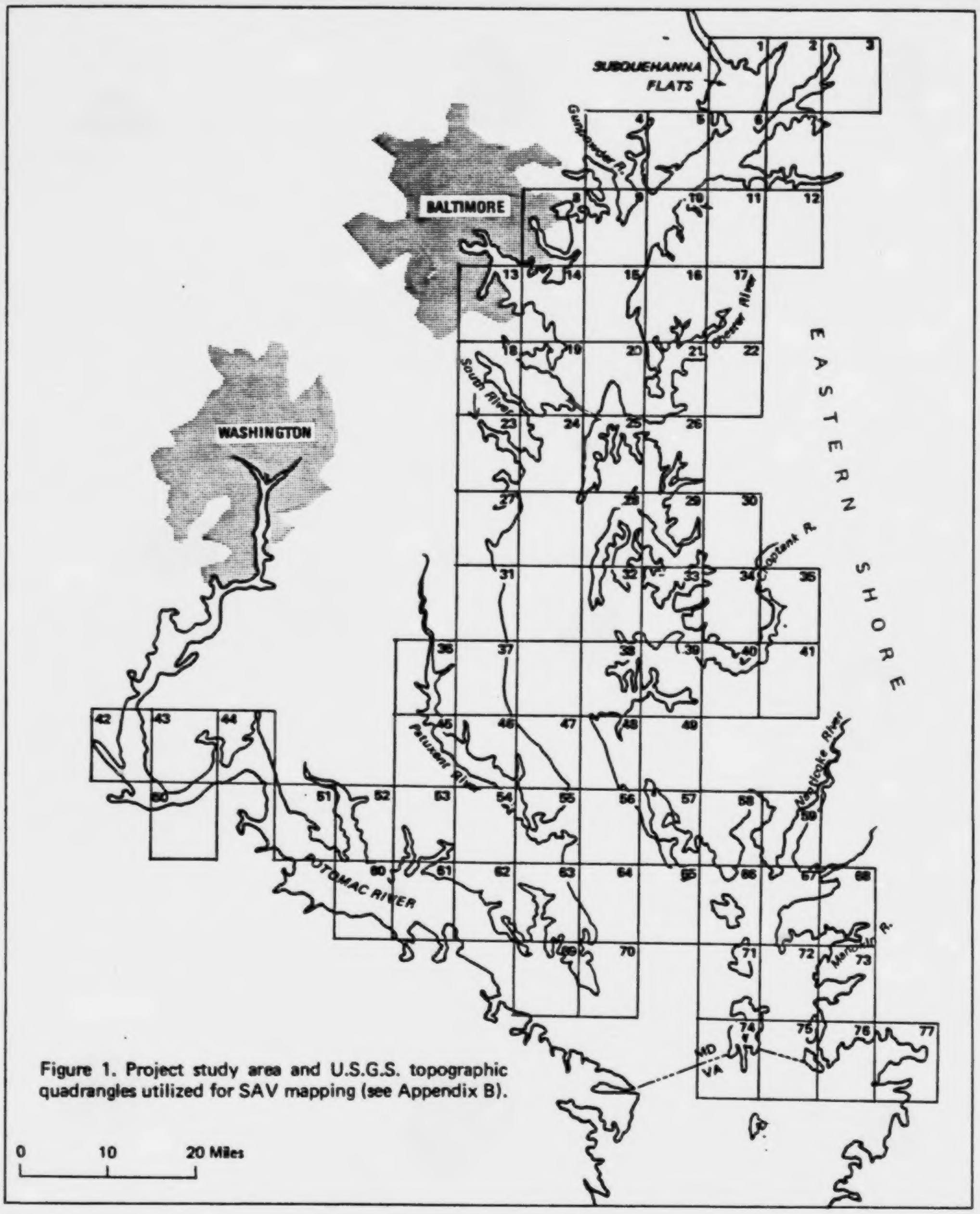
SUSQUEHANNA FLATS
Gunpowder R.
BALTIMORE
Chester River
South River
WASHINGTON
Choptank R.
EASTERN SHORE
Patuxent River
Nanticoke River
POTOMAC RIVER
Manokin R.
MD
VA
0
10
20 Miles

Figure 1. Project study area and U.S.G.S. topographic quadrangles utilized for SAV mapping (see Appendix B).

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TABLE 1. GUIDELINES FOLLOWED DURING ACQUISITION OF AERIAL PHOTOGRAPHS

1. Tidal Stage - Photography was acquired at low tide, +/- 0-1.5 ft., as predicted by the National Ocean Survey tables.

2. Plant Growth - Imagery was acquired when growth stages ensured maximum delineation of SAV, and when phenologic stage overlap was greatest.

3. Sun Angle - Photography was acquired when surface reflection from sun glint did not cover more than 30 percent of frame. Sun angle was generally between 20° and 40° to minimize water surface glitter. At least 60 percent line overlap and 20 percent side lap was used to minimize image degradation due to sun glint.

4. Turbidity - Photography was acquired when clarity of water ensured complete delineation of grass beds.

5. Wind - Photography was acquired during periods of no or low wind. Off-shore winds were preferred over on-shore winds when wind conditions could not be avoided.

6. Atmospherics - Photography was acquired during periods of no or low haze and/or clouds below aircraft. There was no more than scattered or thin broken clouds, or thin overcast above aircraft, to ensure maximum SAV to bottom contrast.

7. Sensor Operation - Photography was acquired in the vertical with less than 5 degrees tilt. Scale/altitude/film/focal length combination permitted resolution and identification of one square meter area of SAV (surface).

8. Plotting - Each flight line included sufficient indentifiable land area to assure accurate plotting of grass beds.

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aircraft preparation at 6:30 a.m. and initiation of the first flight line at 12,000 ft. by 8:30 a.m. Photography would continue until no later than 11:00 a.m. to minimize sun glare on the water. Prior to the onset of the project, 137 flightlines were plotted on 1:250,000 scale U.S.G.S. maps to give 20 percent side lap and 60 percent end lap (Appendices A and B). Approximately 1,780 flightline kilometres were planned. It was not possible to fly portions of some flightlines totalling approximately 14 percent of the planned coverage due to flying restrictions imposed by the Patuxent Naval Air Station restricted area. Those lines not flown are shown in Appendix C. Seaplane reconnaissance was utilized to obtain distribution information where photo coverage was not possible. Supplemental photography was obtained in the Potomac River (Table 2) due to persistent water turbidity problems during good photographic days.

Black-and-white photography was obtained at a scale of 1:24,000 commencing on June 11, 1978 and continuing through early October. Exposed film was processed, annotated and printed on a Log-Etronic electronic dodging printer. Negatives were slightly over-exposed to bring out detail in the water for optimum interpretation of SAV beds on the prints. Flightlines were plotted on 1:24,000 topographic sheets to ensure that proper side and end map had been obtained. The result was over 1,000 photographs annotated according to flightline number and photo number.

Intensive Study Areas

Intensive study areas were selected for detailed examination to determine if species associations and percent cover information could be photointerpreted. Both areas are contained on the Queenstown quadrangle (Queenstown shoreline and Parsons Island). The areas chosen were based upon SAV species composition and availability of field information.

Flightlines for acquisition of aerial photography were established in areas where extensive SAV species information had been obtained by field work. Two camera systems, a Hassleblad 500 EL and the Wild aerial camera were used to obtain multispectral photography. Flightlines were run at 457 m (1,500 ft.), 915 m (3,000 ft.), and 1,829 m (6,000 ft.) ASL. Resultant image scales were 1:3,000, 1:6,000 and 1:12,000, respectively. Black-and-white and natural color photography were obtained simultaneously at each altitude. Figure 2 compares the color and black-and-white photography. Standard photointerpretation techniques were utilized to provide species association and speciation potential information from all altitudes and film types.

FIELD DATA COLLECTION

A Piper Super Cub on oversized floats owned by AeroEco of Reston, Virginia was used as a reconnaissance and ground truth vehicle. It is the ultimate STOL aircraft, used around the world for bush operations where slow flight, maximum control and safety are paramount (See Figure 2a).

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TABLE 2. ADDITIONAL POTOMAC RIVER FLIGHT LINES FLOWN ON DECEMBER 9, 1978 IN AREAS WITH KNOWN SAV BEDS*

Image Annotation	Number of Photographs	Location of Flight Line
POTA 2-13	12	Potomac River northwest of St. Clements Island Northeast of Potomac River to Rt. 301 bridge.
PT 1-3	3	Windmill Point north up the Port Tobacco River.
NP 1-13	13	Headwaters on Nanjemoy Creek south to confluence with Potomac then up the north shore of the Potomac to a point opposite MCAS Quantico.
WS 1-9	9	Headwaters of Wicomico River south to Cobb Island and confluence of Potomac River.

* Potomac River Quad sheet Nos.

42, 43, 44, 50, 51, 52, 53, 60, 61, 62, 63, 69, 70.

(See Appendix B)

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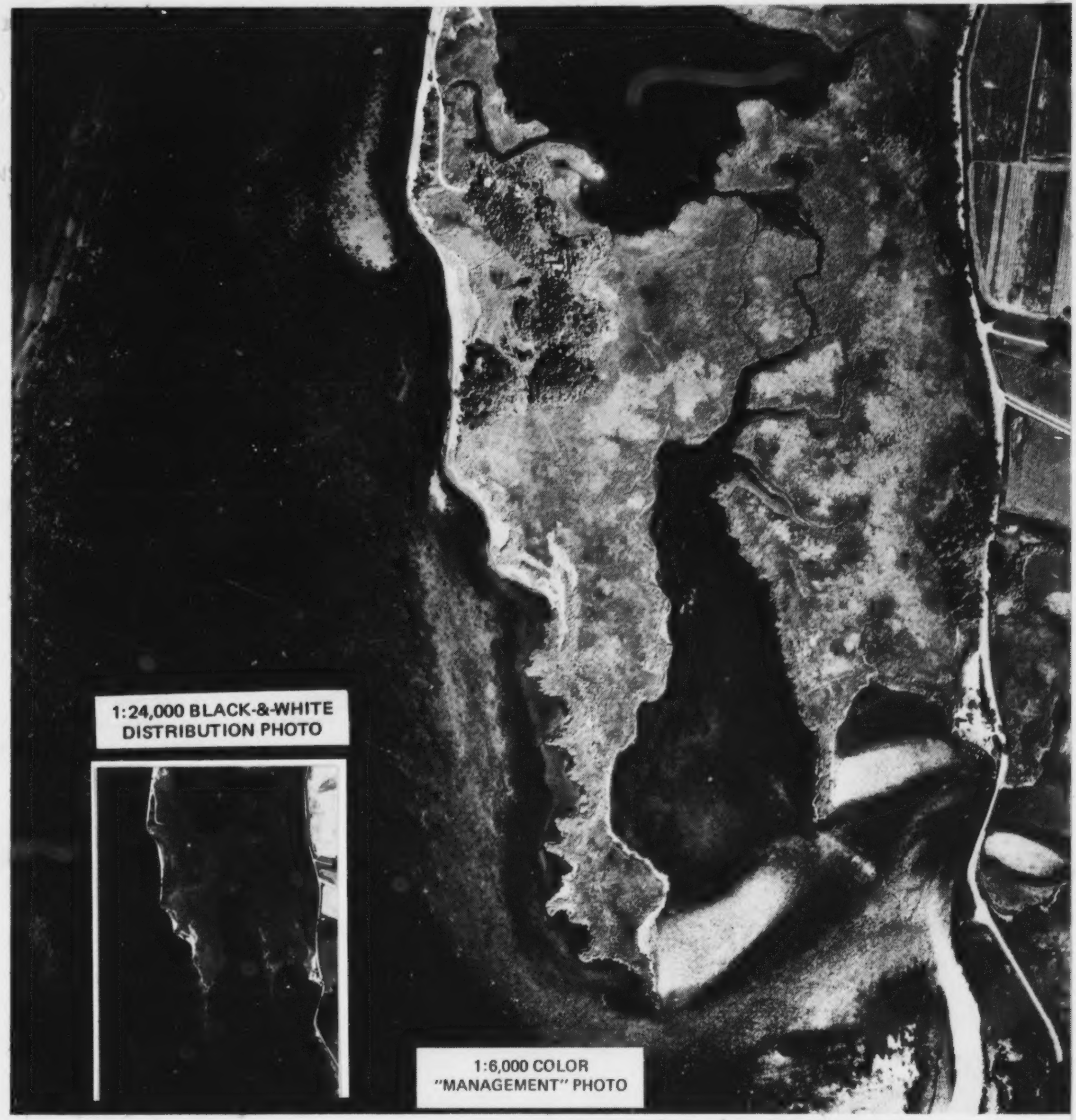
1:24,000 BLACK-&-WHITE DISTRIBUTION PHOTO
1:6,000 COLOR "MANAGEMENT" PHOTO

Figure 2. A comparison of the capabilities of 1:24,000 scale black-and-white photography (suitable for distribution mapping of large areas) and 1:6,000 scale color photography (suitable for management level mapping to include percent cover and species association).

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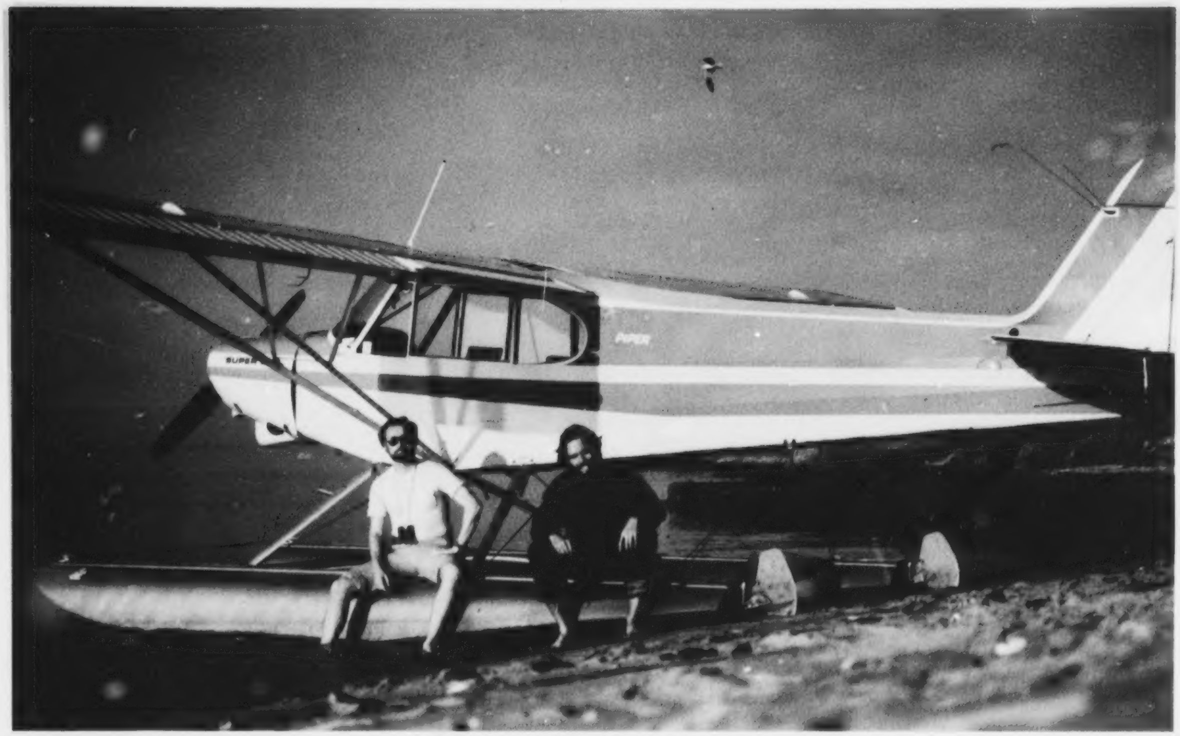

Figure 2a. A Piper SuperCub on oversized floats owned by AeroEco of Reston, Virginia, was used as a reconnaissance and ground truthing vehicle. It is the ultimate STOL aircraft. It can take off at 15 mph in 60 m (200 ft) and circle an area at 20 mph, allowing photointerpreters helicopter-like opportunity to view SAV.

It can take off at 15 mph in 60 m (200 ft.) and circle an area at 20 mph allowing photointerpreters helicopter-like opportunity to view SAV. It is more stable and safer than a helicopter at low altitudes in the event of power failure and has three times the fuel to remain on the job all day. With a draft of 15 cm (6 in.), it was operated routinely up in the headwaters of creeks and inlets where the SAV beds concentrate in the Chesapeake Bay. The field team was able to travel from the Annapolis base of operations to any work area on the Bay within one hour.

Slow-flight reconnaissance of the shoreline at altitudes ranging from 15 m (50 ft.) to 1,525 m (5,000 ft.) enabled the interpreters to see SAV bed distribution from above. Field prints were annotated to show growth of vegetation that occurred or beds that were obscurred by local turbidity conditions at the time of photography. Areas having an unusual signature on the field prints were viewed first from above and then on the surface. Species association information was noted at all locations where a landing was made. Accurate bed delineation included ascertaining if the photograph showed maximum bed distribution, and updating the field print if it did not. Updating was necessary in several areas (since only one set of photos was affordable). Small beds not visible on the photography were delineated on the field print from the seaplane. In areas where localized turbidity obscurred SAV beds on the photo, the beds were delineated on the field print.

The seaplane was particularly important in obtaining species information in selected SAV beds. Since time was critically short and funds were limited for the project, it was important to utilize field time in a very efficient manner. Not all beds could be investigated for species information within the constraints of the project. The largest beds on each quadrangle sheet area were selected for field investigation. The extent of the bed was ascertained from the air. The seaplane was landed near the bed and subsequent random transects provided species composition information. In single species and/or small diversity beds, it was possible to extrapolate species composition to other beds while in the air. Species information is not as complete as it would have been on some maps if the Maryland State Survey had been conducted during 1978.

MAP PRODUCTION

Quad sheet mylar copies at a scale of 1:24,000 were purchased from the U.S. Geological Survey for each of the 77 maps to be produced. The mylar copy included the blue, black, red, and purple overlay colors as seen on the paper quad sheets. The four overlays were composited in one black line frosted mylar by the U.S.G.S. photo laboratory.

Delineation of SAV bed boundaries was facilitated by superimposing the appropriate aerial photo on the quad sheet over a light table. Both the negative air photo and the positive field prints were utilized to give the photointerpreter the maximum advantage of the first generation negative and the field information on the positive print. SAV boundaries were delineated in pencil on the frosted side of the quadrangle sheet mylar basemap. Species information and location were annotated at the same position along the shoreline as derived from the field prints.

This method of direct transfer of photointerpretive SAV information was efficient and cost effective. Scale adjustment equipment such as the Map-O-Graph or Zoom Transfer Scope were not required. Any minor scale differences that were evident between the aerial photos and quadrangle sheet were compensated for by "floating" the photo beneath the quadrangle to obtain the "best fit." At locations where there was significant shoreline erosion or accretion since the production of the quadrangle sheet (some are circa 1940's), the photo was used as the new shoreline control, and a new shoreline line code was used on the maps to indicate a photographic update.

Each mylar quadrangle sheet manuscript was checked and matched for consistency of information and line matching at the edges before final drafting. A permanent ink was used for final cartographic production. Coordination between the Virginia Institute of Marine Science (VIMS) mapping program and this effort was arranged at the onset of the programs. A map code was developed by which plant species information, where available, could be placed on the maps (see Table 3).

An understanding was reached between the two mapping programs as to the responsibilities of each in the common or border quads between Maryland and Virginia. The Virginia shoreline vegetation along the Potomac River was mapped by The American University. Each program mapped up to the Maryland/Virginia border in the eastern shore waters. Thus, a complete set of maps was produced for each state with duplication of the border quads in each set.

Areas of SAV beds were derived from the 1:24,000 scale topographic quadrangles utilizing a Numonics Graphics Calculator. Measurements were made by the U.S. Fish and Wildlife Service and provided to The American University.

ARCHIVAL PHOTOGRAPHIC STUDY

The American University has, in past and ongoing projects, routinely conducted searches for archival photographic data for specific study areas. These same techniques were utilized for this project.

The initial phase of this part of the project involved conducting an intensive search of governmental and private sources of aerial photography. Table 4 shows a list of sources queried for archival photography. The Aerial Photographic Summary Record System (APSRS), National Cartographic Information Center was the most useful source of information. The APSRS describes existing, in-progress and planned U.S. aerial photography. Descriptive catalogs and computer listings on microfiche are provided as well as computer printouts of coverage over specific geographic areas.

TABLE 3. VEGETATION CODE UTILIZED TO ANNOTATE SUBMERSED PLANT SPECIES INFORMATION ON MAPS

Plant Species	Map Code
Vallisneria americana Michx.	Va
Potamogeton perfoliatus L.	Pr
Potamogeton pectinatus L.	Pc
Ruppia maritima L.	Rm
Zannichellia palustris L.	Zp
Najas sp.	N
Elodea canadensis Michx.	Ec
Myriophyllum spicatum L.	Ms.
Ceratophyllum demersum L.	Cd
Zostera marina L.	Zm

TABLE 4. LIST OF SOURCES QUERIED FOR ARCHIVAL PHOTOGRAPHY

Governmental

National Cartographic Information Center
507 National Center
Reston, Virginia 22092

Aerial Photography Field Office
USDA-ASCS
2222 West 2300 South
P.O. Box 30010
Salt Lake City, Utah 84125

Eastern Mapping Center NCIC
U.S. Geological Survey
536 National Center
Reston, Virginia 22092

National Archives and Records Service
Cartographic Archives Division, Rm. 2W
8th & Pennsylvania Ave., N.W.
Washington, D.C. 20408

NOAA, National Ocean Survey
6001 Executive Boulevard
Rockville, Maryland 20852
Attn: Coastal Mapping Division

DMA Headquarters
Defense Mapping Agency
Bldg. 56, U.S. Naval Observatory
Washington, D.C. 20305
Attn: PPS

Army Corps of Engineers
P.O. Box 1715
Baltimore District
Baltimore, Maryland 21203

State of Maryland
Dept. of State Planning
301 W. Preston Street
Baltimore, Maryland 21201

TYPING GUIDE SHEET

TABLE 4 (Continued)

Private

Air Survey Corporation
Newton Square South
Reston, Virginia 22090

Mark Hurd Aerial Surveys, Inc.
345 Penn. Avenue South
Minneapolis, Minnesota 55426

Air Photographic, Inc.
2421 Linden Lane
Silver Spring, Maryland

Each catalog uses outline map indexes to reference the geographic coverage, time of acquisition, scale range, and acquiring organization for aerial photographs in a 15 degree strip of the United States. Supplementing the catalogs are computer printouts in four microfiche sets that list the amount of cloud cover, type of camera, specific scale, date of coverage and agency acronym (e.g., NASA) for each catalog symbol. APSRS microfiche is designed for use on 48X readers. Each fiche (105 x 148 mm) may contain up to 269 full pages of computer listings.

The Aerial Photography Field Office of the U.S. Department of Agriculture provides aperture card index sheets containing photo mosaics of coverage over the contiguous United States. The National Archives contains negatives of older aerial photography flown mainly by the Defense Intelligence Agency. Negatives were viewed at the Archives and frames selected for specific areas.

A major portion of the time required for this project involved viewing the various aerial photographic data and selecting frames suitable for SAV interpretation. Much of the data was taken at times other than the SAV growing season or had excessive cloud cover. Appendices D, E and F show sources, dates, and identification numbers for all data utilized to map SAV distribution in the three test areas.

Test areas were selected on the basis of availability of past SAV survey data and appropriate photographic coverage over a broad span of time. Test site "1" covers the Eastern neck - Choptank River; test site "2" covers the Eastern Bay area; test site "3" covers a portion of the Gunpowder River, and Dundee, Saltpeter and Seneca Creeks.

SAV distribution by date was plotted on mylar overlays to the U.S.G.S. 1:24,000 topographic sheets. Data varying in scale from 1:125,000 to 1:10,000 was brought to a common scale through use of a Focalmatic desk projector or by projecting 35 mm slide copies on the overlays of the topographic sheets. The latter proved more efficient than producing prints as an intermediate step in transferring distribution information to the overlays.

SECTION 5

RESULTS AND DISCUSSION

AERIAL PHOTOGRAPHY

Entire Project Area

Approximately 1,530 flightline kilometres were photographed during the period from June to October, 1978 to cover 86 percent of the project area. Over 21 days of flight time were required including some that were scrubbed due to weather, poor water conditions or restrictions imposed due to military flights in the area. The original, annotated negatives are archived at the EPA, EPIC Laboratories in Warrenton, Virginia.

The black-and-white photography proved to be a useful medium for ascertaining the location and distribution of SAV beds in the project area. An exception to this was the later onset of growth of *Ruppia maritima* (July) which meant the June photography did not show the complete distribution of this species. The June photography was annotated with bed distribution of *Ruppia* later in the summer to facilitate transfer to maps.

Intensive Study Areas

The result of the Intensive Study Area Project was that 1:6,000 scale color photography flown during ideal tide, sun angle, turbidity and wind conditions was required for management level mapping. Interpretation of all types and scale photography demonstrated the following:

- Color photography is superior to black-and-white at 1:3,000 and 1:6,000 scales for differentiation of SAV species. At 1:12,000 scale, speciation is not interpretable on color or black-and-white photography.

- Distribution delineation accuracy increases as the scale of the photography increases.

- The minimum mapping unit dimensions decrease as the scale of the photography increases. The minimum mapping unit of 1.25 x 0.64 cm on the map ranges from 7.6 x 19 m to 23 x 57 m on the ground, depending upon scale. Smaller beds are interpretable, but percent cover and species association information is not interpretable nor can it be recorded without undue map clutter. Figure 2 compares color with black-and-white photography for SAV bed distribution and species association.

SUBMERSED AQUATIC PLANT DISTRIBUTION

Map Production

SAV was mapped where established as present by aerial photographs and/or field study. The map base was U.S.G.S. 1:24,000 quadrangle mylars. A total of 77 quadrangles covered the project area. The minimum mappable bed size was approximately 0.25 hectares. Appendix G is a series of photoreproductions of each quadrangle sheet where mappable vegetation was found to be present. There were 17 sheets with no mappable vegetation present and 24 sheets that had less than 10 hectares of vegetation (Table 5). Approximately 95 percent of the vegetation occurred in 37 of the 77 maps.

General Distribution of SAV

A total of over 7,500 hectares (18,600 acres) of SAV were mapped over the entire study area. Figure 3 shows the Maryland portion of the Chesapeake Bay with a generalized indication of where SAV are distributed.

In order to regionalize the discussion of SAV distribution, a modification of Stewart's (1962) Biogeographical Sections classification system will be used. Those Sections which correspond to the tidal portions of the upper Chesapeake Bay are shown in Figure 4.

Susquehanna Flats Section--

This section encompasses the area known as Susquehanna Flats and also the Northeast River. Stewart described the area in 1962 as having tremendous beds of a variety of SAV, being widespread throughout the section. The 1978 survey results showed vegetation being restricted to the Susquehanna Flats and composed mostly of *M. spicatum*. Small beds of *V. americana* were also present. A total of 110 hectares of vegetation were mapped.

Upper Eastern Shore Section--

This section encompasses the Elk, Bohemia and Sassafrass Rivers. Stewart described this section as having quite turbid waters and relatively few extensive beds of SAV, being restricted to shallow water near shore. The 1978 survey indicated little change in water conditions or SAV distribution. Only 29 hectares of vegetation were mapped, these being small beds of *M. spicatum*, *V. americana* and *P. pectinatus*.

TABLE 5. LIST OF U.S. GEOLOGICAL SURVEY 1:24,000 TOPOGRAPHIC QUADRANGLES WHICH WERE USED TO MAP DISTRIBUTION OF SUBMERSED VEGETATION

Havre de Grace
North East**
Elkton**
Edgewood**
Perryman*
Spesuite**
Earleville**
Middle River
Gunpowder Neck
Hanesville**
Betterton**
Galena**
Curtis Bay
Sparrows Point**
Swan Point
Rock Hall
Chestertown**
Round Bay
Gibson Island
Love Point
Langford Creek
Centerville
South River
Annapolis
Kent Island
Queenstown
Deale
Claiborne
St. Michaels
Easton**
North Beach*
Tilghman
Oxford
Trappe
Preston*
Bennedict**
Prince Frederick*
Sharps Island
Church Creek
Cambridge
East New Market*
Widewater*
Nanjemoy
Mathias Point
Mechanicsville
Broomes Island**
Cove Point**
Taylors Island*
Golden Hill*
King George**
Colonial Beach North
Rock Point
Leonardtown**
Hollywood*
Solomons Island**
Barren Island*
Honga
Nanticoke*
Wingate**
Stratford Hall**
St. Clements Island**
Piney Point*
St. Mary's City*
Point No Point*
Richland Point**
Bloodsworth Island
Deale Island**
Monie**
St. George Island*
Point Look-Out*
Kedges Straits
Terrapin Sand Point
Marion
Ewell
Great Fox Island
Crisfield
Saxis

Listed in order to read from right to left and from north to south as shown on the U.S. Geological Survey Index to topographic maps of Maryland.

* - No vegetation recorded during the 1978 survey.

** - Less than 10 hectares of vegetation recorded during 1978 survey.

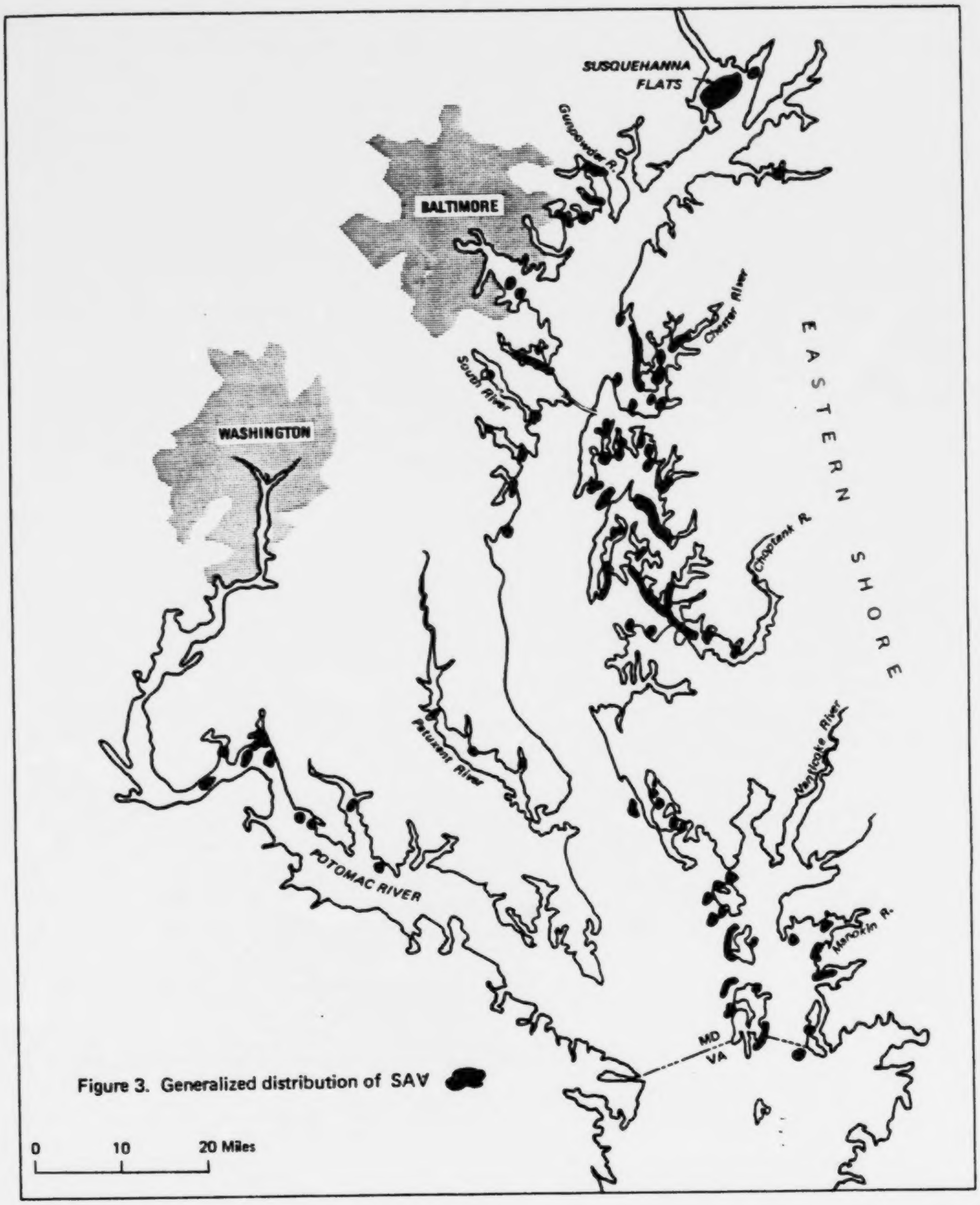
SUSQUEHANNA FLATS
Gunpowder R.
BALTIMORE
Chester River
EASTERN SHORE
South River
WASHINGTON
Choptank R.
Patuxent River
Nanticoke River
POTOMAC RIVER
Manokin R.
MD
VA
0
10
20 Miles

Figure 3. Generalized distribution of SAV ●

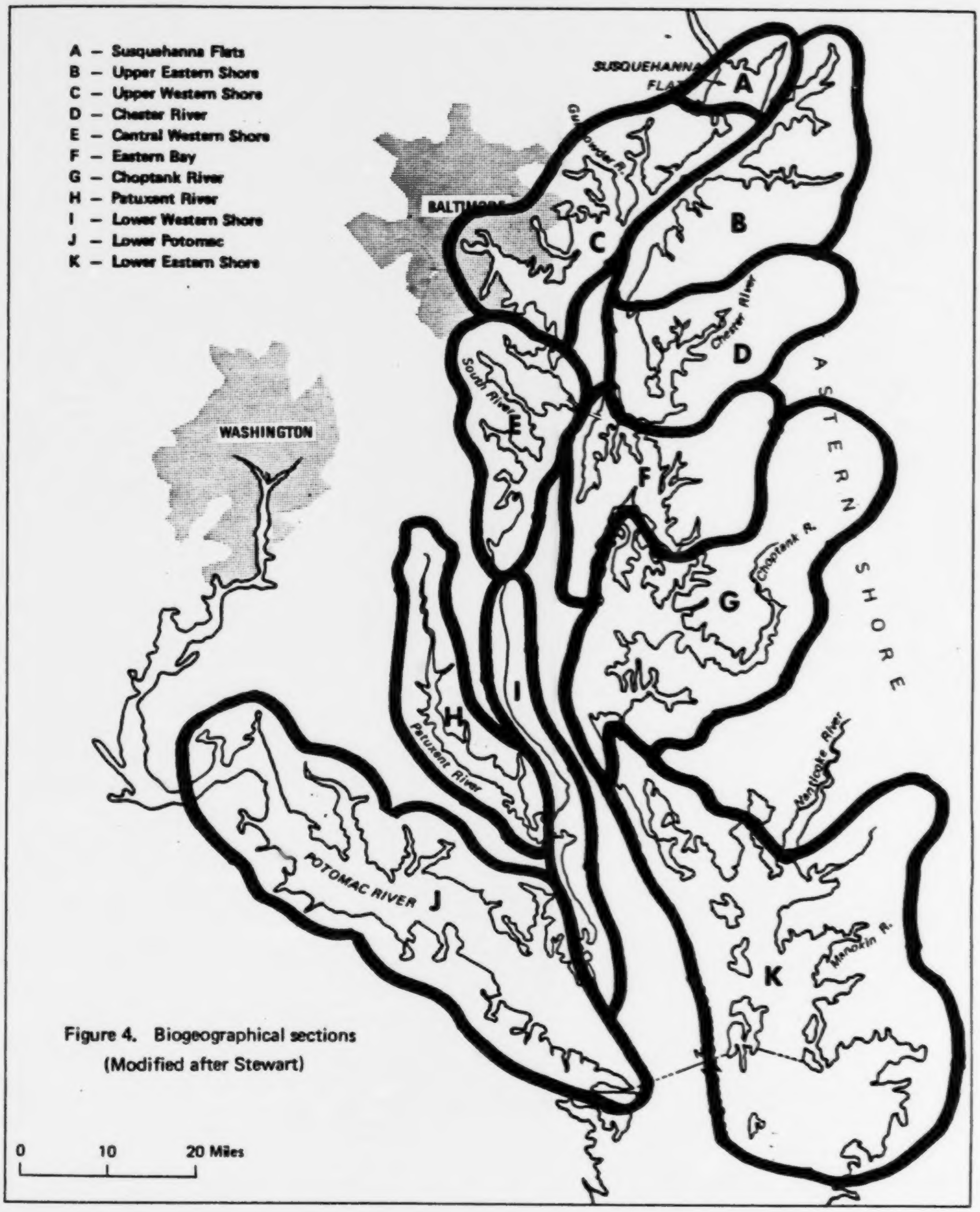
A – Susquehanna Flats
B – Upper Eastern Shore
C – Upper Western Shore
D – Chester River
E – Central Western Shore
F – Eastern Bay
G – Choptank River
H – Patuxent River
I – Lower Western Shore
J – Lower Potomac
K – Lower Eastern Shore
SUSQUEHANNA FLATS
BALTIMORE
WASHINGTON
Gunpowder R.
Chester River
South River
Choptank R.
Patuxent River
POTOMAC RIVER
Nanticoke River
Manokin R.
EASTERN SHORE
A
B
C
D
E
F
G
H
I
J
K
0
10
20 Miles

Figure 4. Biogeographical sections
(Modified after Stewart)

Upper Western Shore Section--

This section encompasses the Bush, Gunpowder, Middle and Back Rivers and Baltimore Harbor. Stewart described this section as having abundant SAV throughout except for localized industrial pollution which caused extensive damage to nearby beds. He reported recent establishment of *M. spicatum* and waterchestnut. The 1978 survey showed the presence of 345 hectares of SAV being composed of *P. perfoliatus*, *M. spicatum*, *V. americana* and *E. canadensis*.

Chester River Section--

This section covers the drainage basin that makes up the Chester River. Stewart described this section as having great beds of SAV. The 1978 survey showed that this section has a large hectarage of SAV (1,475 h). It also supports a very diverse assemblage of SAV species including *M. spicatum*, *P. perfoliatus*, *E. canadensis*, *P. pectinatus*, *V. americana*, *Z. palustris* and *R. maritima*.

Central Western Shore Section--

This section encompasses the Magothy, Severn, South and West Rivers and Herring Bay. Stewart described this section as having great SAV beds localized within numerous sheltered coves, bays and inlets. The 1978 survey showed the presence of 380 hectares of SAV composed of a diverse assemblage of species. These include *M. spicatum*, *P. perfoliatus*, *P. pectinatus*, *V. americana*, *Z. palustris*, *R. maritima* and *Najas* sp.

Eastern Bay Section--

This section is a large, shallow embayment with several creeks and rivers as tributaries. These include the Wye, East, and Miles Rivers. Stewart described this area as having abundant growth of SAV. The 1978 survey resulted in mapping of 1,800 hectares of SAV, the most abundant section. This area also supports a diversity of SAV including *M. spicatum*, *P. perfoliatus*, *P. pectinatus*, *E. canadensis*, *Z. palustris*, and *R. maritima*.

Choptank River Section--

This section includes the drainage basin of the Choptank River and associated water bodies such as Harris and Broad Creeks, Tred-Avon and Little Choptank Rivers and Trippe Bay. Stewart described this area in 1962 as having extensive SAV beds including *P. perfoliatus*, *R. maritima*, *P. pectinatus*, *E. canadensis* and some beds of *Z. marina*. The 1978 survey resulted in 1,740 hectares of SAV being mapped. The following species were observed: *M. spicatum*, *P. pectinatus*, *P. perfoliatus*, *E. canadensis*, and *Z. palustris*.

Patuxent River Section--

This section includes the tidal portion of the Patuxent River and associated water bodies such as Swanson, Battle, and St. Leonard Creeks. Stewart reported extensive beds of SAV up to Swanson Creek where the water was too turbid to support growth. Reports of species composition from Stewart and Anderson (1969) indicated a diverse assemblage of SAV species including M. spicatum, P. pectinatus, P. perfoliatus, E. canadensis, R. maritima, Najas, and Z. palustris. The 1978 survey resulted in mapping of only 3 hectares of SAV over the whole reach of this system, indicating a significant decline in distribution and abundance. Only small beds of Z. palustris and R. maritima remain.

Lower Western Shore Section--

This section consists of a section of shoreline from Herring Bay to the mouth of the Potomac River. Stewart reported this area not suitable for SAV growth. The 1978 survey indicates the same conditions. Only 11 hectares of SAV were mapped.

Lower Potomac River Section--

This section has been modified from Stewart to encompass two sections from his system. It extends from Nanjemoy Creek to the mouth of the Potomac, and includes the Wicomico River. Stewart reported great beds of SAV in the upper part of this section but being restricted to near shorelines in the lower part. The 1978 survey resulted in mapping of 450 hectares over the entire section. Species included were M. spicatum, P. perfoliatus, P. pectinatus and R. maritima.

Lower Eastern Shore Section--

This section extends from the Honga River to Smith Island at the Maryland/Virginia border. It includes Fishing Bay, the Nanticoke, Wicomico, Manokin and Big Annemessex Rivers. Stewart reported the presence of P. pectinatus in Honga River and absent further south. No other SAV species are listed. The 1978 survey resulted in mapping of 1,155 hectares of SAV with the following species: P. pectinatus (Honga River), R. maritima, Z. palustris and small beds of Z. marina.

Figure 5 shows acreage of the Biogeographical sections plotted separately for the eastern and western shores. The mid-Bay sections show the highest distribution, and the upper Bay sections the lowest. There is also a much lower distributional pattern on the western shore.

Comparison With U.S. Fish and Wildlife Service Survey (USFWS), 1971-1977

The U.S.F.W.S., Migratory Bird and Habitat Research Laboratory (MBHRL) established a SAV sampling program in 1971, which encompassed the Maryland portion of the Chesapeake Bay. More recently it has been

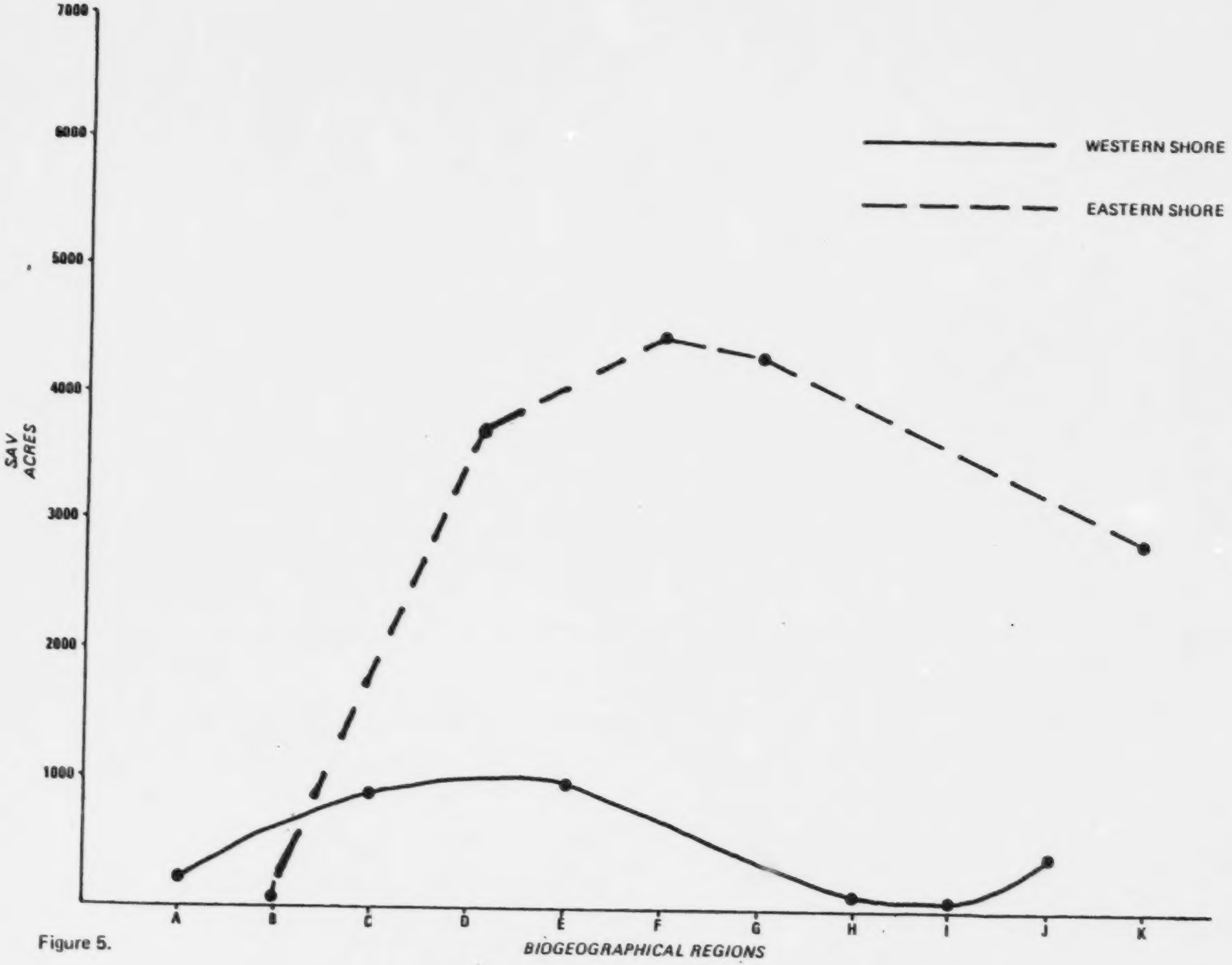
7000
6000
5000
4000
3000
2000
1000
SAV ACRES
WESTERN SHORE
EASTERN SHORE
A
B
C
D
E
F
G
H
I
J
K
BIOGEOGRAPHICAL REGIONS

Figure 5.

conducted by the Maryland Department of Natural Resources. Approximately 650 stations were selected at random with 26 river systems groups. The acreage of shoal water (8 ft. or less in depth at mean low water) was determined for the entire area. The acreage of shoal water within each river system, as compared to the entire area, was utilized to distribute sample stations and determine sampling intensity.

In order to estimate the accuracy of the MBHRL sampling survey we obtained coordinates of sampling stations from the MBHRL and plotted them on 1:24,000 topographic maps. A total of 609 points were plotted in all river systems except the Potomac River. Sampling station locations were compared to the true position of SAV beds on 1978 maps showing distribution of SAV. Table 6 shows the number of MBHRL sampling stations which fell within approximately 100 m of the true location of a SAV bed. The number of sampling stations intersecting SAV beds ranged from 0 to 5. Of the total of 609 sampling stations, 64 fell within 100 m of the true location of SAV beds as shown on our maps in 1978. Thus, approximately 10 percent of the MBHRL sample points might fall within a SAV bed. The number of sampling stations showing vegetation in 1977 was 12 percent according to the Maryland DNR data. Our 10 percent figure for 1978 may be on the conservative side due to the difficulty of judging if a sampling station was close enough to assume a bed would be encountered. However, preliminary Maryland DNR data for 1978 (Stotts, personal communication) indicates 9-10 percent of their stations had submersed vegetation.

ARCHIVAL PHOTOGRAPHIC STUDY

Photographic Data

Aerial photographic data were located which spanned a period of 34 years. Appendices D through F show the portion of this photography which was used to map SAV distribution in each test area. For test site "1", a total of 62 photographs spanning time between 1936 and 1978 were utilized to determine SAV distribution for 11 different years. Good data were lacking between 1936 and 1952.

For test site "2", data were located which spanned the time interval between 1937 and 1978. A total of 65 photographs were reviewed. For test site "3", data were found which spanned the interval between 1952 and 1978 including data before and after installation of a power generating station that discharges into Salt Peter Creek.

Historial SAV Distribution

Table 7 shows trends in distribution of SAV at the three sites. As can be seen, the Eastern Bay site had the least usable data and the Chester River site the most. Figure 6 shows a plot of SAV distribution from 1952 to 1978 for the Chester River and Seneca/Salt Peter Creek area test sites. Trends in distribution are somewhat difficult to interpret from this time period due to the influx of *M. spicatum* over the entire upper Chesapeake Bay.

TABLE 6. SHOWS THE NUMBER OF FISH AND WILDLIFE SERVICE SAMPLE POINTS PER QUAD SHEET AND THE NUMBER OF INTERSECTING BEDS AS DETERMINED BY THE AMERICAN UNIVERSITY, 1978 SURVEY

SHEET	AREA	FWS SAMPLE PTS.	FWS PTS. INTERSECTING BEDS	1978 ACREAGE
Kent Island	Chester R./Eastern Bay	15	3	1269
Queenstown	Eastern Bay/Wye East R.	12	4	1215
Deale	Herring Bay/West R.	10	none	152
Claiborne	Eastern Bay/Harris Cr.	14	3	1040
St. Michaels	Miles R./Wye East R. Broad Cr.	14	6	904
Easton	Tred Avon R.	1	none	18
North Beach	Herring Bay	2	none	none
Tilghman	Broad Cr./Ches. Shoreline	9	1	1181
Oxford	Tred Avon R./Edge Cr.	11	3	1390
Trappe	Peachblossom Island/Trippe Crs.	5	2	160
Preston	Choptank R.	4	none	none
Benedict	Patuxent R.	10	none	4
Prince Frederick	Ches. Shoreline	5	none	none
Sharps Island	Choptank, Little Choptank R. Trippe Bay	21	5	931
Church Cr.	Choptank, Little Choptank R. Fishing Cr.	9	none	516
Cambridge	Choptank R.	10	2	121
East New Market	Choptank R.	1	none	none
Widewater	Potomac R.	none	none	none
Nanjemoy	Potomac R.	none	none	69
Mathias Point	Potomac R.	none	none	430
Mechanicsville	Patuxent R.	6	none	34
Broomes Island	Patuxent R.	5	none	12
Cove Point	Leonard Cr./Ches. Shoreline	5	none	7
Taylors Island	Slaughter Cr./Ches. Shoreline	13	none	none
Golden Hill	Honga R.	none	none	none

(CONTINUED)

TABLE 6 (CONTINUED)

SHEET	AREA	FWS SAMPLE PTS.	FWS PTS. INTERSECTING BEDS	1978 ACREAGE
King George	Potomac R.	none	none	5
Havre De Grace	Susquehanna Flats	20	3	273
North East	Northeast River	6	none	14
Elkton	Elk River/Back Cr.	5	1	1.8
Edgewood	Gunpowder/Bush R.	6	1	26
Perryman	Bush R.	1	none	none
Spesutie	Susq. Flats/Elk, Sassafras R.	11	none	2
Earlville	Elk R.	9	none	11.5
Middle River	Middle/Back R.	11	1	222
Gunpowder Neck	Gunpowder R./Seneca Cr.	8	3	495
Hanesville	Churn Cr./Worton Cr.	6	1	23
Betterton	Stillpond Cr.	1	none	15
Galena	Sassafras R.	7	none	3.5
Curtis Bay	Patapsco R./Curtis Cr.	12	2	83
Sparrows Point	Patapsco R./Back R.	9	none	26
Swan Point	Tavern Cr./Swan Cr.	4	2	74
Rock Hall	Langford Cr.	8	3	314
Chestertown	Chester R.	2	1	30
Round Bay	Magothy R./Severn R/	8	3	339
Gibson Island	Magothy R./Severn R.	12	2	344
Love Point	Chester R.	4	none	29
Langford Cr.	Chester R/Eastern Neck	17	4	3100
Centreville	Chester R./Corsica Cr.	none	none	95
South River	South R./Rhode R.	4	none	37
Annapolis	South R./Severn R.	9	none	67
Colonial Beach N.	Potomac River	none	none	no data
Rock Point	Wicomico R.	none	none	56

(CONTINUED)

TABLE 6 (CONTINUED)

SHEET	AREA	FWS SAMPLE PTS.	FWS PTS. INTERSECTING BEDS	1978 ACREAGE
Leonardtown	St. Clement Bay/Breton Bay	none	none	6
Hollywood	Patuxent R.	1	none	none
Solomons Island	Patuxent R.	20	none	26
Barren Island	Tar Bay	5	none	none
Honga	Honga R./Ches. Shoreline	40	2	314
Nanticoke	Fishing Bay/Nanticoke R.	17	none	none
Wingate	Fishing Bay/Nanticoke R.	16	none	7
Stratford Hall	Potomac River	none	none	14
St. Clements Island	Potomac River	none	none	0.3
Piney Point	Potomac River	none	none	none
St. Marys City	St. Marys R.	none	none	none
Point No Point	Hooper Island	2	none	1.8
Bloodsworth Island	Tangier Sound/Ches. Shoreline	33	1	163
Deale Island	Tangier Sound/Nanticoke, Wicomico Manokin Rivers	15	none	7
Monie	Wicomico, Manokin Rvs./Monie Bay	10	none	23
St. George Island	Potomac River	none	none	none
Point Lookout	Potomac River	none	none	none
Kedges Straits	Holland Straits, Kedges Straits Tangier Sound	19	1	385
Terrapin Sand Pt.	Tangier Sound	9	none	777
Marion	Manokin, Big Annemessex R.	17	4	715
Ewell	Smith Island	8	1	87
Great Fox Island	Smith Island/Little Annemessex River	8	1	353
Crisfield	Pocomoke Sound/Little Annemessex Riv.	18	none	18
Saxis	Pocomoke Sound/Little Annemessex Riv.	7	none	none
	TOTAL	609	64	45,063

TABLE 7. TRENDS IN EXTENT OF SUBMERGED VEGETATION DISTRIBUTION (ACRES) AS DETERMINED BY ARCHIVAL AERIAL PHOTOGRAPHY

Date	Chester River	Eastern Bay	Gunpowder River/ Salt Peter, Seneca Crs.
1936	3478	——	——
1937	——	2170	——
1952	1900	——	926
1957	2548	——	802
1960	2890	——	2173
1963	3480	——	——
1964	——	——	2194
1965	2315	——	——
1969	3870	——	——
1970	4032	1470	734
1972	1555	——	——
1978	3100	1215	568

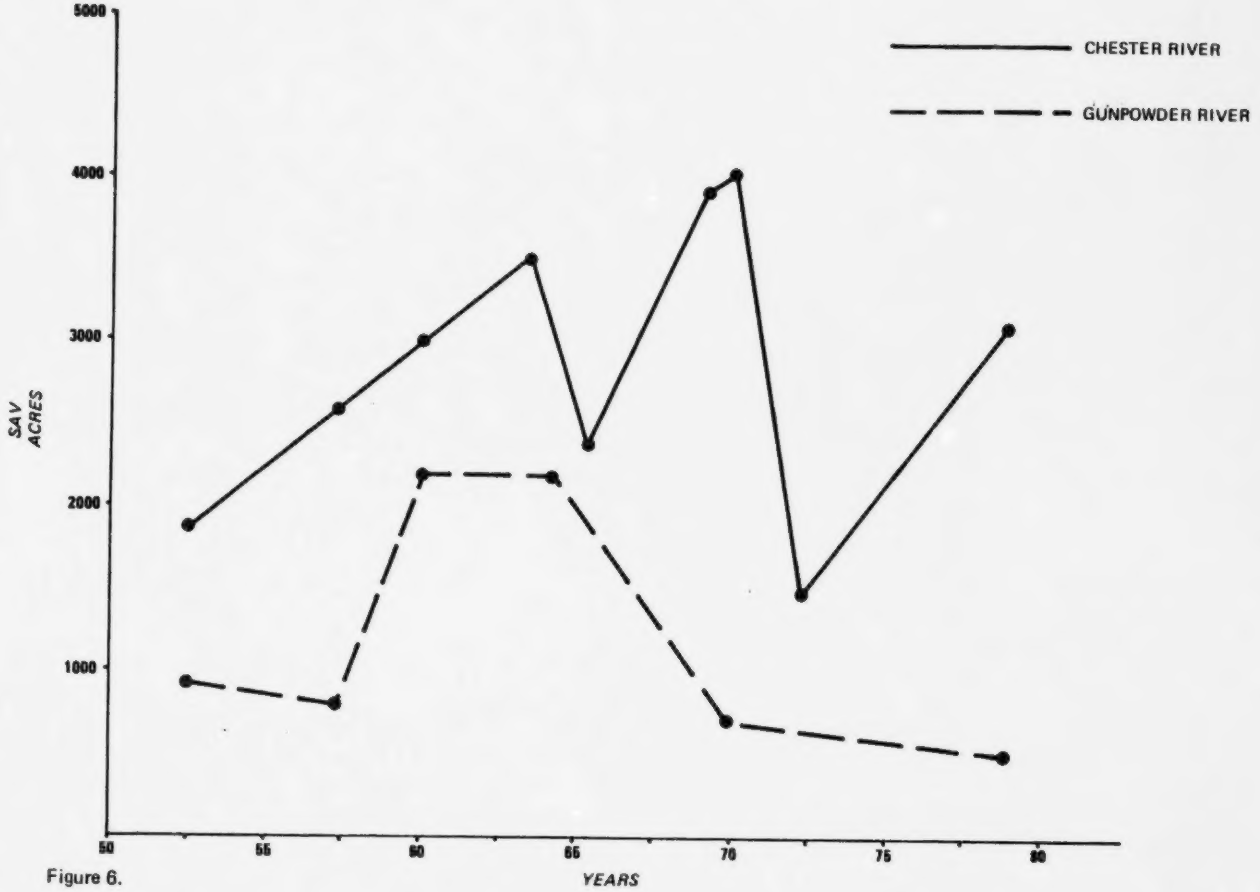
CHESTER RIVER
GUNPOWDER RIVER
SAV
ACRES
5000
4000
3000
2000
1000
50
55
60
65
70
75
80
YEARS

Figure 6.

In the Chester River there is an increase in distribution until the early 1960's, a decline, another increase to 1970 and a drastic decline after a hurricane in 1972. There is an encouraging trend toward greater distribution in 1978. Figure 7 shows a series of illustrations of trends in distribution in the Chester River from 1952 to 1978.

In the Seneca/Salt Peter Creeks site there is also a trend toward greater distribution to the mid 1960's, then a significant decline, with stabilization through the 1978 survey. Figure 8 shows a series of illustrations of trends in distribution from 1952 to 1978.

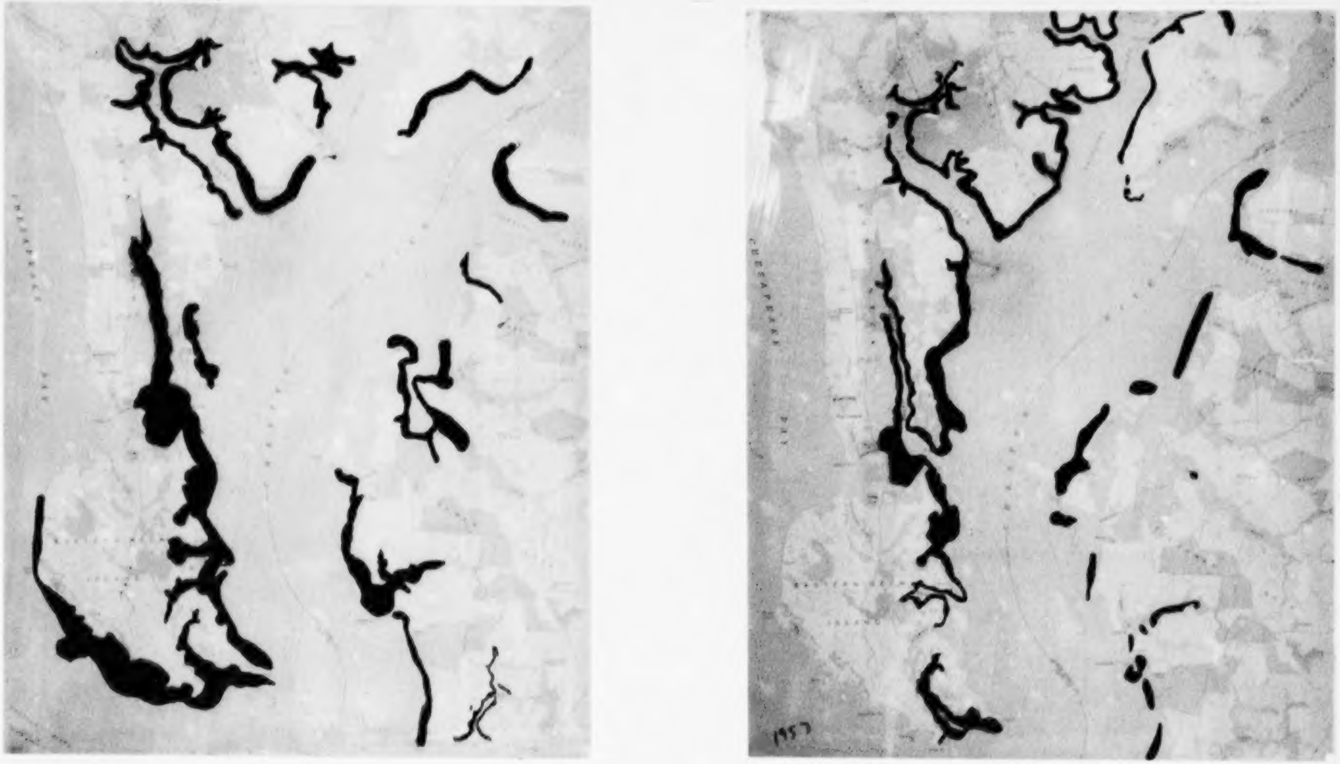
CHESAPEAKE BAY
CHESAPEAKE BAY
1957

Figure 7 Chester River SAV distribution, 1952 and 1957 (R)

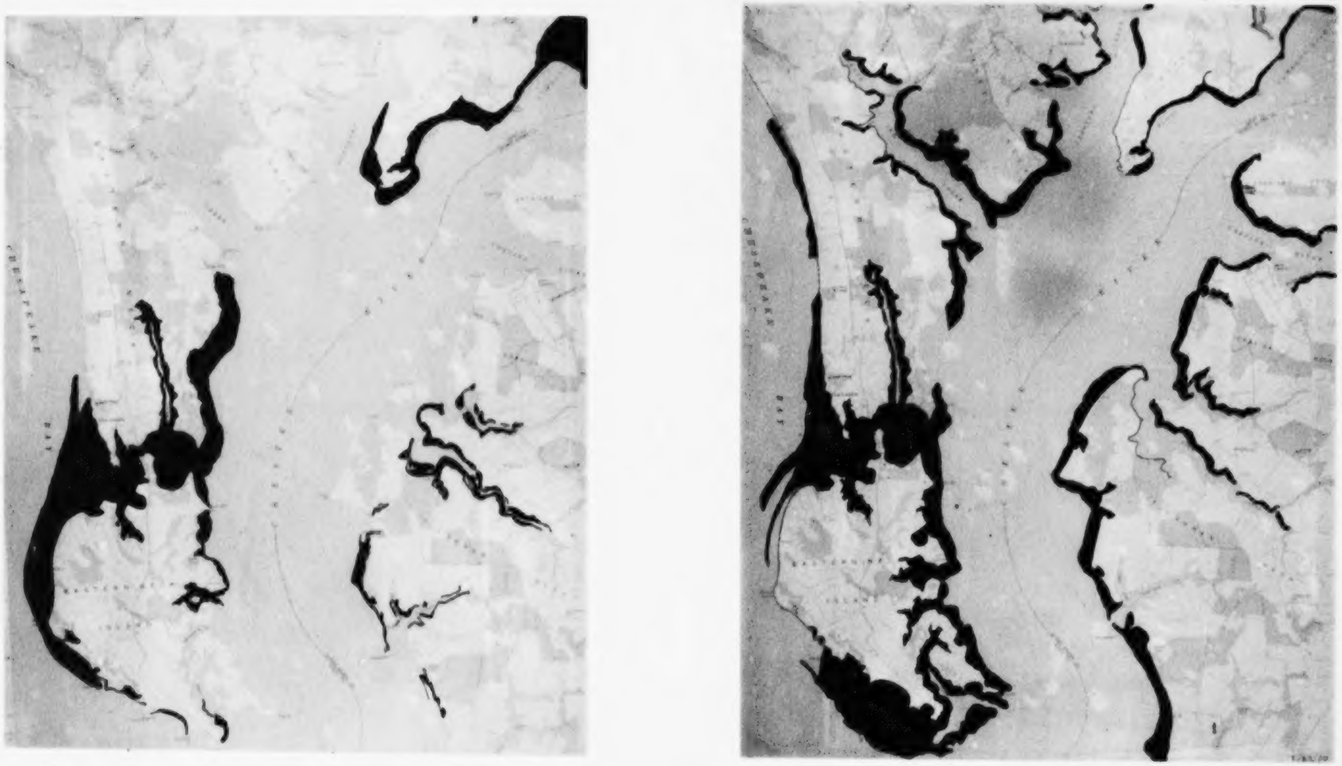
CHESAPEAKE
BAY
CHESAPEAKE
BAY

Figure 7 cont. Chester River SAV distribution, 1965 and 1970 (R)

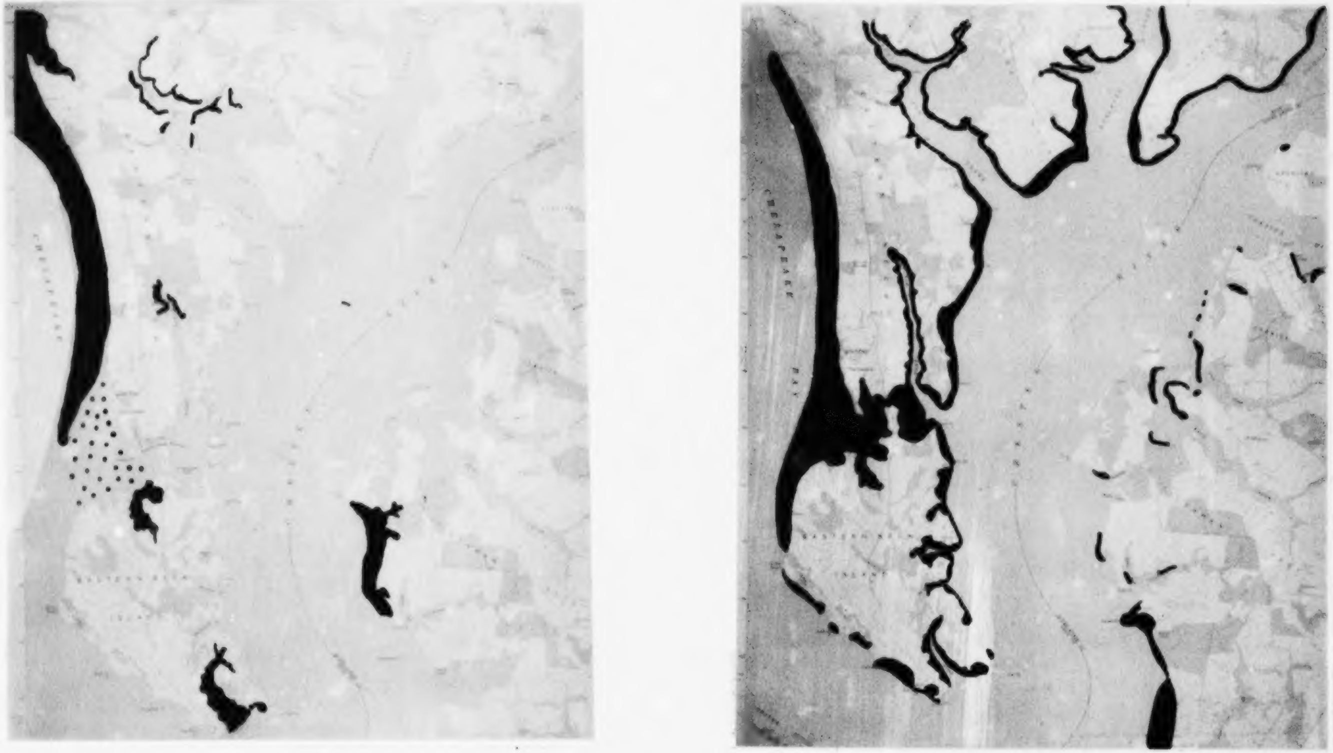
CHESAPEAKE
CHESAPEAKE
BAY

Figure 7 cont. Chester River SAV distribution, 1972 and 1978 (R)

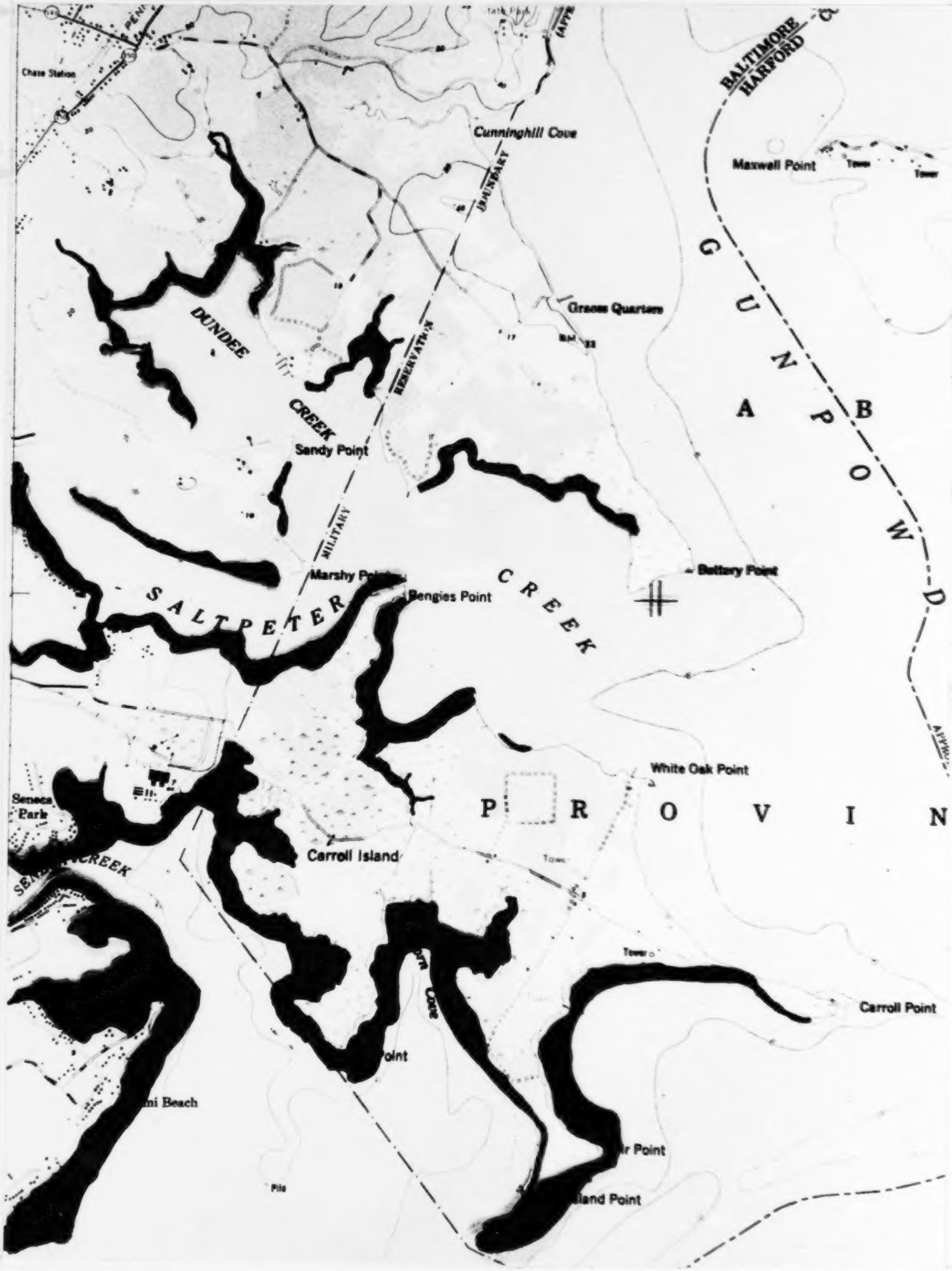
Chase Station
BALTIMORE
HARFORD
Cunninghill Cove
Maxwell Point
Tower
Tower
BOUNDARY
Grasss Quarters
DUNDEE
CREEK
RESERVATION
GUNPOWDER
A
B
Sandy Point
MILITARY
Marshy Point
Battery Point
Bengies Point
SALTPETER
CREEK
White Oak Point
Seneca Park
PROVIN
Carroll Island
SENECA CREEK
Tower
Tower
Carroll Point
Cove
Point
Beach
Point
Island Point

Figure 8 Salt Peter/Seneca Creek SAV distribution, 1952

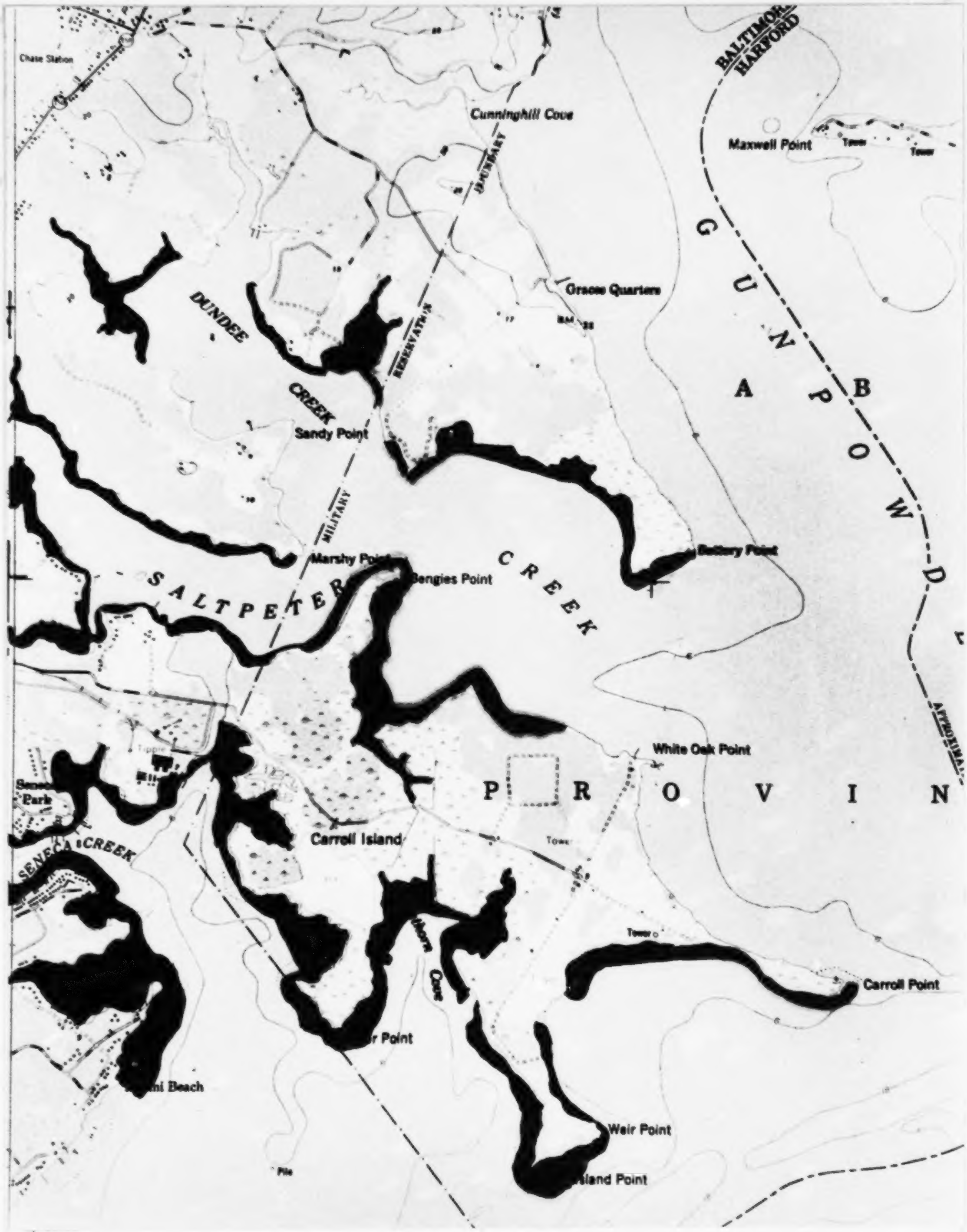
Chase Station
BALTIMORE
HARFORD
Cunninghill Cove
Maxwell Point
Tower
Tower
BOUNDARY
GUNPOWDER
Gracee Quarters
BM
DUNDEE CREEK
RESERVATION
A
B
Sandy Point
MILITARY
Marshy Point
Bengies Point
Battery Point
SALTPETER CREEK
APPROXIMATE
White Oak Point
PROVIN
Seneca Park
Carroll Island
SENECA CREEK
Tower
Cove
Carroll Point
Point
Beach
Weir Point
Island Point
Pile

Figure 8 cont. Salt Peter/Seneca Creek SAV distribution 1957

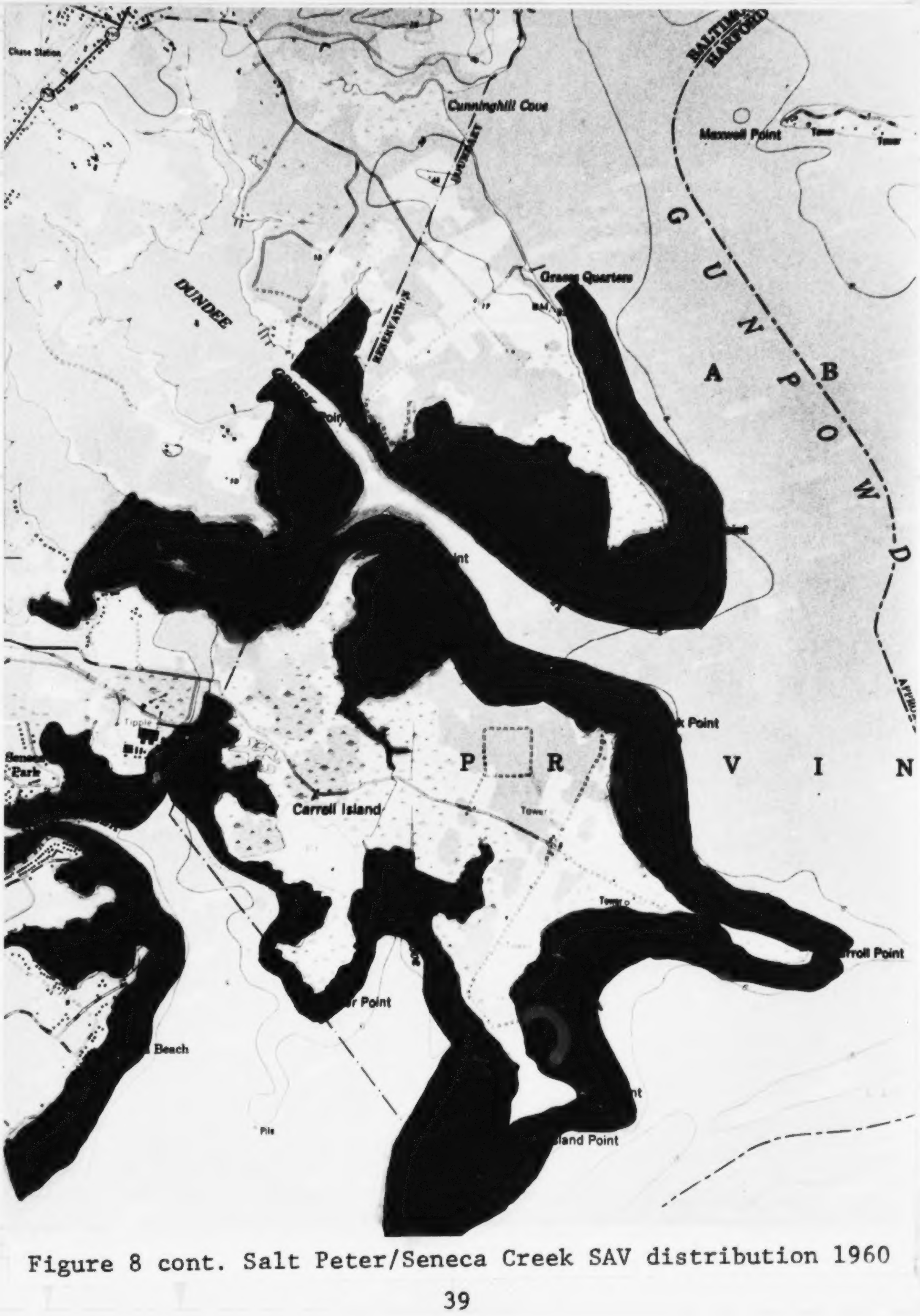
Chase Station
Cunninghill Cove
BALTIMORE
HARFORD
Maxwell Point
Tower
Tower
DUNDEE
RESERVATION
Grace Quarters
G U N P O W D
A B
Seneca Park
Tipple
Carroll Island
P R V I N
Tower
Tower
Carroll Point
Beach
Pile
Island Point

Figure 8 cont. Salt Peter/Seneca Creek SAV distribution 1960

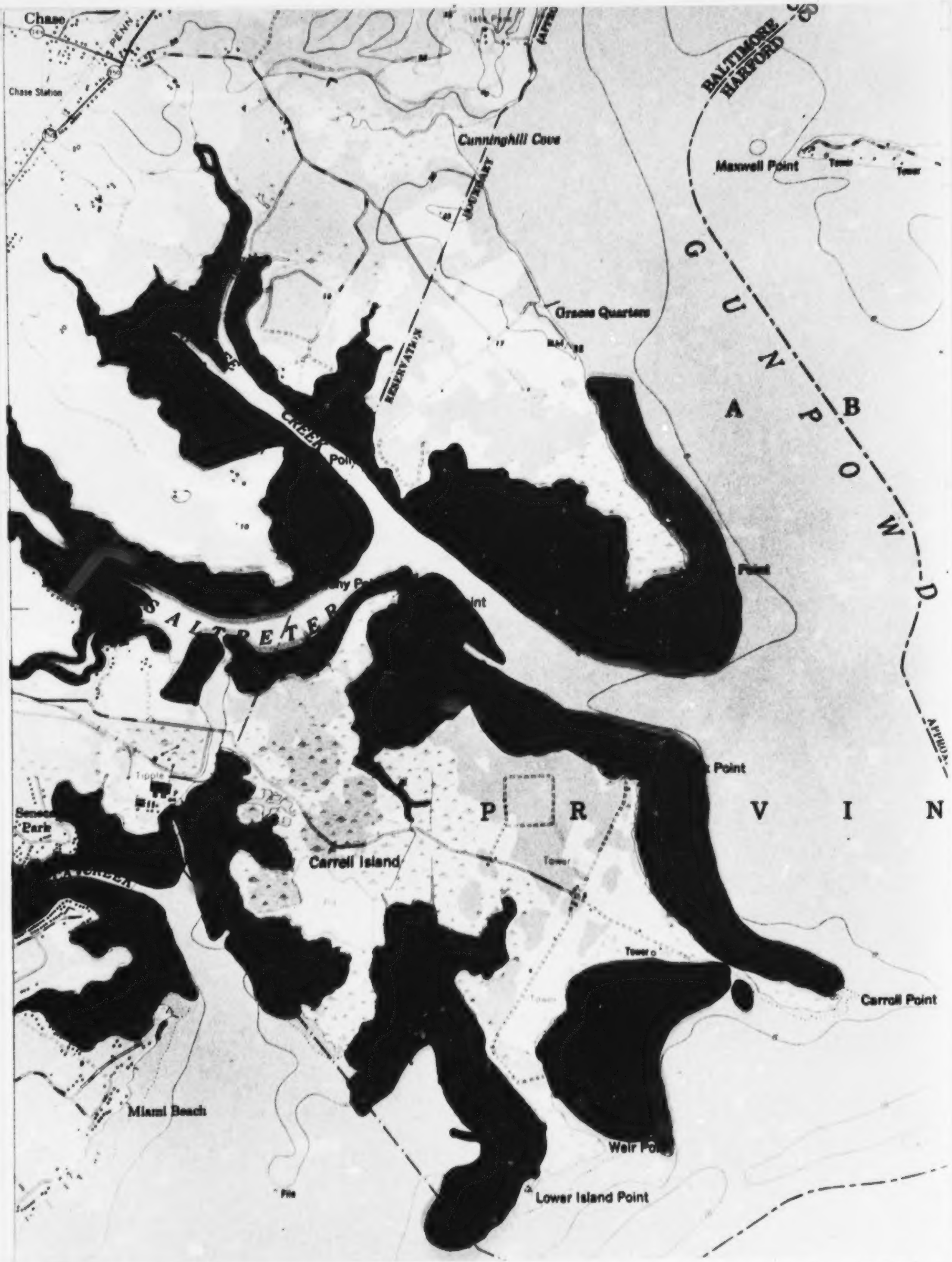
Chase
Chase Station
Cunninghill Cove
BOUNDARY
BALTIMORE
HARFORD
Maxwell Point
Tower
Tower
G U N P O W D
Graces Quarters
RESERVATION
CREEK
A
B
Point
Point
S A L T P E T E R
Point
Point
Seneca Park
Tipple
P R V I N
Carroll Island
Tower
Tower
Carroll Point
Miami Beach
Weir Point
Lower Island Point
APPROX

Figure 8 cont. Salt Peter/Seneca Creek SAV distribution 1964

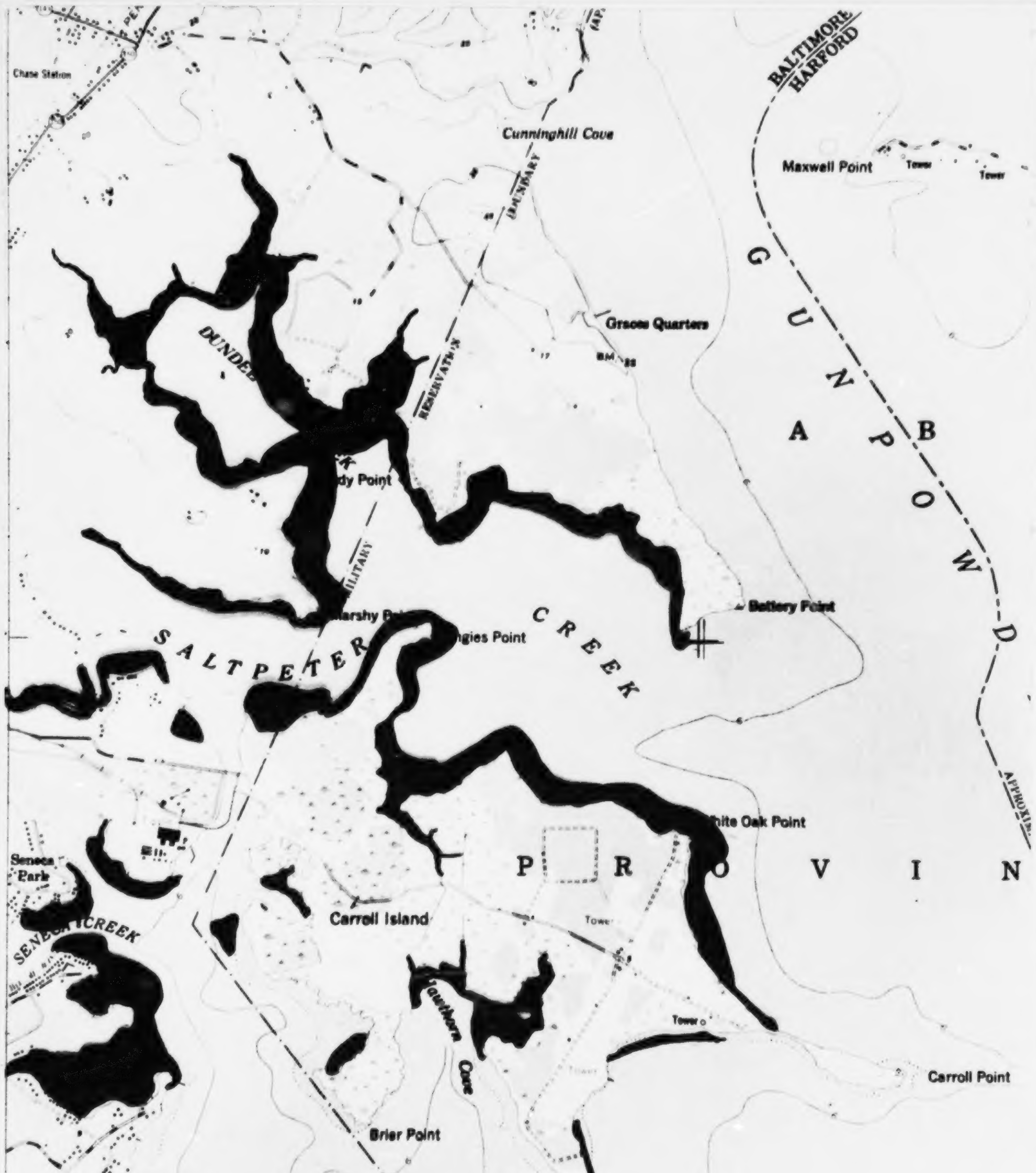
Chase Station
Cunninghill Cove
BALTIMORE
HARFORD
Maxwell Point
Tower
Tower
BOUNDARY
RESERVATION
MILITARY
DUNDEE
Graces Quarters
BM
GUNPOWDER
A
B
dy Point
Battery Point
Marshy Pt
ngies Point
SALTPETER CREEK
White Oak Point
APPROXIM
PROVIN
Seneca Park
SENECA CREEK
Carroll Island
Tower
Tower
Hawthorn Cove
Carroll Point
Brier Point
Miami Beach
Weir Point
Pile
Lower Island Point

Figure 8 cont. Salt Peter/Seneca Creek SAV distribution 1971

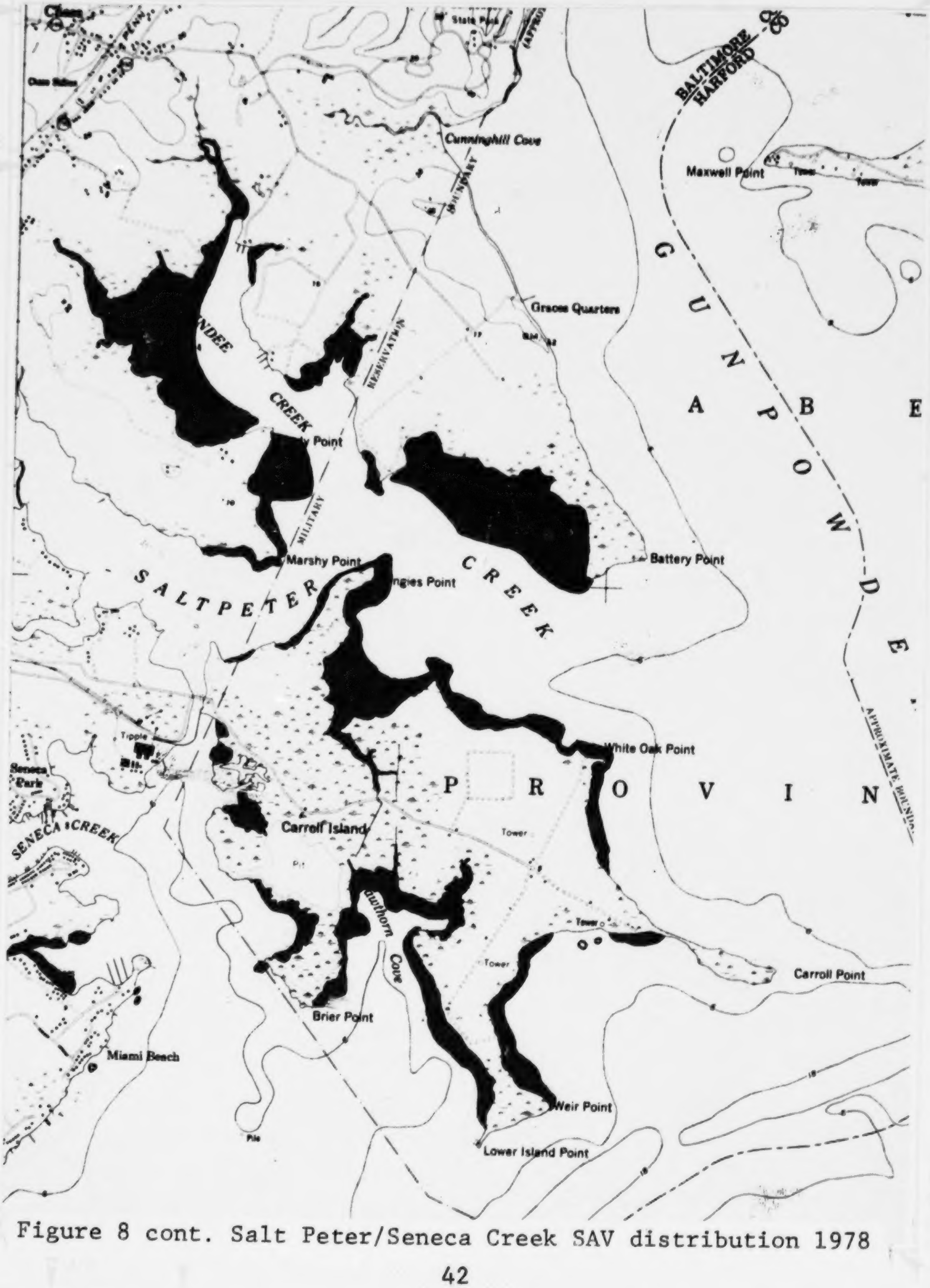
Cunninghill Cove
BALTIMORE
HARFORD
Maxwell Point
GUNPOWDER
Graces Quarters
RESERVATION
MILITARY
BOUNDARY
DUNDEE CREEK
Marshy Point
SALTPETER CREEK
Battery Point
ABERDEEN PROVING
White Oak Point
APPROXIMATE BOUNDARY
Tipple
Seneca Park
SENECA CREEK
Carroll Island
Tower
Hawthorn Cove
Carroll Point
Brier Point
Miami Beach
Weir Point
Lower Island Point
Pile

Figure 8 cont. Salt Peter/Seneca Creek SAV distribution 1978

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APPENDIX A

FOR INFORMATION ON APPENDIX A
PLEASE CONTACT:

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Chesapeake Bay Program
2083 West Street, Suite 5G
Annapolis, MD 21401

APPENDIX B

SHOWS AERIAL PHOTOGRAPHIC FLIGHTLINES AS PLOTTED ON 1:250,000 MAPS KEYED TO U.S. GEOLOGICAL SURVEY 1:24,000 QUAD SHEETS

Sheet No.	Quad Sheet Name	Flight Lines
1	Havre de Grace	1,3,5
2	North East	1,3,4,5
3	Elkton	2,4,5
4	Edgewood	8,11,13
5	Perryman	6,8,11,13
6	Spesuite	5,7,9,12,14
7	Earleville	5,7,10,12,14
8	Middle River	13,14,17,19
9	Gunpowder Neck	13,15,17,19
10	Hanesville	13,16,18,20
11	Betterton	14,16,18
12	Galena	14,16
13	Curtis Bay	19,21,24,27,29
14	Sparrows Point	19,21,24,27,29
15	Swan Point	25,28,30
16	Rock Hall	20,22,25,28,30
17	Chestertown	23,26,28,30
18	Round Bay	29,31,33,35,37

19	Gibson Island	29,31,33,35,37
20	Love Point	36,38
21	Langford Creek	30,32,34,36,38
22	Centreville	30,32,34
23	South River	37,39,41,43
24	Annapolis	37,39,41,43
25	Kent Island	38,40,42,44
26	Queenstown	38,40,42,44
27	Deale	43,45,47,49,51
28	Claiborne	44,46,48,50,52
29	St. Michaels	44,46,48,50,52
30	Easton	44,46,48,50,52
31	North Beach	51,54,57,61,65
32	Tilghman	52,55,58
33	Oxford	52,55,59,62,66
34	Trappe	52,53,55,56,59,62,66
35	Preston	53,56,60,63,66
36	Bennedict	64,67,70,74
37	Prince Frederick	65,58,71,75
38	Sharps Island	66,69,72,76
39	Church Creek	66,69,72,76
40	Cambridge	66,69,73
41	East New Market	66,69
42	Widewater	77,82,87,92
43	Nanjemoy	78,83,88

44	Mathias Point	78,83,88
45	Mechanicsville	74,49,84
46	Broomes Island	79,84,89,94
47	Cove Point	75,80,85,89,90,94,95
48	Taylors Island	76,81,86,91,96
49	Golden Hill	86,91,96
50	King George	92
51	Colonial Beach North	93,98,102,106
52	Rock Point	93,98,102,106,109
53	Leonardtown	102,106,109
54	Hollywood	94,99,103
55	Solomons Island	94,95,99,103,107
56	Barren Island	96,100,104
57	Honga	96,100,104,108,111
58	Nanticoke	97,101,104,105,108,111
59	Wingate	97,101,105,108,111
60	Stratford Hall	109,112
61	St. Clements	109,112
62	Piney Point	109,110,112,115,118
63	St. Marys City	110,112,115,118
64	Point No Point	112,115,118
65	Richland Point	111
66	Bloodsworth Island	111,113,116,119
67	Deale Island	111,114,117,120
68	Monie	111,114,117,120

69	St. George Island	118,121,124
70	Point Look Out	118,121,124,127
71	Kedges Straits	119,122,125,128,130
72	Terrapin Sand Point	120,123,126,128,129, 130,131
73	Marion	120,123,126,129,131
74	Ewell	130,132,134,136
75	Great Fox Island	130,131,132,133,134, 135,136,137
76	Crisfield	131,133,135,137
77	Saxis	131,133

APPENDIX C

APPROXIMATE LENGTH IN KILOMETRES OF EACH FLIGHT LINE OVER WHICH AERIAL PHOTOGRAPHY WAS ACQUIRED

Flight Line	Distance (km)	Flight Line	Distance (km)
1	13.75	38	16.75
2	3.75	39	13.75
3	12.00	40	18.75
4	7.25	41	12.75
5	25.00	42	23.50
6	3.50	43	6.25
7	26.50	44	26.00
8	7.00	45	6.50
9	5.75	46	24.75
10	16.75	47	7.50
11	21.25	48	24.75
12	12.00	49	4.75
13	21.25	50	26.75
14	23.75	51	3.75
15	20.00	52	28.00
16	26.75	53	4.50
17	21.25	54	3.50
18	11.50	55	23.75
19	25.00	56	4.25
20	7.75	57	2.75
21	18.50	58	5.75
22	8.50	59	13.75
23	5.00	60	7.50
24	14.50	61	2.50
25	9.25	62	8.50
26	6.00	63	3.00
27	12.50	64	3.50
28	26.25	65	3.00
29	12.75	66	30.75
30	20.00	67	5.00
31	7.75	68	3.25
32	20.75	69	30.00
33	17.50	70	7.00
34	15.50	71	2.50
35	18.50	72	13.00
36	17.50	73	5.00
37	17.75	74	3.75

Flight Line	Distance (km)	Flight Line	Distance (km)
75	3.00	111	35.00
76	20.50	112	19.00
77	3.25	113	7.75
78	12.00	114	11.25
79	10.00	115	Not flown
80	3.75	116	9.25
81	8.75	117	19.25
82	2.25	118	Not flown
83	13.75	119	10.25
84	8.00	120	19.50
85	6.75	121	Not flown
86	8.25	122	9.00
87	2.25	123	18.25
88	13.00	124	7.50
89	15.50	125	4.75
90	3.00	126	10.75
91	6.50	127	3.25
92	9.50	128	9.00
93	17.00	129	12.75
94	12.50	130	11.25
95	3.75	131	Not flown
96	7.00	132	9.25
97	Not flown	133	Not flown
98	16.00	134	5.25
99	13.75	135	Not flown
100	Not flown	136	5.00
101	Not flown	137	Not flown
102	20.50		
103	12.75		
104	Not flown		1565.5 flown
105	Not flown		217.75 not flown
106	26.25		13.9% not flown
107	Not flown		
108	36.25		
109	21.75		
110	Not flown		

APPENDIX D

ARCHIVAL PHOTOGRAPHY USED TO MAP VEGETATION DISTRIBUTION IN THE CHESTER RIVER

Source	Identification Number	Date
House	Roll/Frame	M/D/Y
	3 204	9/22/70
	3 205	
	4 7133 - 3A	9/22/70
	4 7094	
	10 6744	9/22/70
	17 8532	5/18/71
	29 5915	7/7/70
	29 5918	
	29 5935	
	29 5937	
	30 54	7/7/70
	30 55	
	31 6415	9/15/69
National Archives		
	NA38-19	8-10/1936
	NA38-26	8-10/1936
National Oceanic and Atmospheric Administration		
	NOAA-164	10/4/65
	165	"
	162	"
	140	7/4/63
	124	10/4/65
	125	"
	126	"
	127	"
	128	"
	161	"
	163	"
	60	7/16/60

	98			"
	99			"
	100			"
	101			"
	102			"
	103			"
	104			"
	105			"
	106			"
	180			"
	181			"
	182			"
	183			"
	184			"
	59			"
	NOAA-97			7/16/60
	NOAA-160			10/4/65
Soil Conservation Service				
	SCSKE1^{1}P			1952
	SCSKE2^{1}P			1957
	SCSKE5^{1}P			1964
	SCSKE8^{1}P			1972
	SCSQA2^{1}P			1952
	SCSQA2^{2}P			"
	SCSQA2^{3}P			"
	SCSQA6^{2}P			1957
	SCSQA6^{3}P			"
	SCSQA9^{1}P			1964
	SCSQA10^{1}P			"
	SCSQA12^{1}P			1972
	SCSQA12^{2}P			"
	SCSQA13^{1}P			"
AMES-NASA				
	Cassette	Mission	Frames	Date
	102	93	113	11/4/71
	"	"	114	"
	"	"	125	"
	102	"	126	"

APPENDIX E

ARCHIVAL PHOTOGRAPHY USED TO MAP VEGETATION DISTRIBUTION IN THE EASTERN BAY AREA

Source	Identification Number	Date
House	Roll/Frame	M/D/Y
	3 127	9/22/70
	3 201	
	3 202	
	3 130	
	3 200	
	3 199	
	4 7096	9/22/70
	4 7097	
	4 7133	
	10 6782	9/22/70
	10 6746	
	10 6783	
	10 6747	
	16 127	5/18/71
	17 8533	5/18/71
	17 8534	
	28 1298	9/13/69
	28 1226	
	28 1225	
	28 1223	
	28 1217	
	29 5939	7/7/70
	29 5941	
	29 5913	
	30 56	7/7/70
	30 57	
	31 6428	9/15/69
	31 6429	
National Archives		
	NA38-28	8-10/37
	NA38-29	8-10/37

National Oceanic and Atmospheric Administration				
	MAP T	NOAA-117		7/16/70
		116		"
		46		"
		45		"
		44		"
		NOAA-174		7/16/60
		175		"
		176		"
		177		"
		178		"
		65		"
		64		"
		63		"
		62		"
		96		"
		95		"
	MAP U	NOAA-143		6/1/63
		242		10/4/65
		142		6/1/63
		155		10/4/65
		156		"
		157		"
		139		7/4/63
		138		"
		137		"
		132		"
		131		"
		130		"
Soil Conservation Service				
		SCSQA2^{1}P		1952
		SCSQA2^{2}P		"
		SCSQA2^{3}P		"
		SCSQA6^{2}P		1957
		SCSQA6^{3}P		"
		SCSTA1^{1}P		1952
		SCSTA2^{1}P		1957
		SCSTA4^{1}P		1964
		SCSTA7^{1}P		1972
AMES		Cassette	Frame	
		124	515-558 (*516-520)	7/31/76
		594	405-632 (*182-166)	8/11/72

APPENDIX F

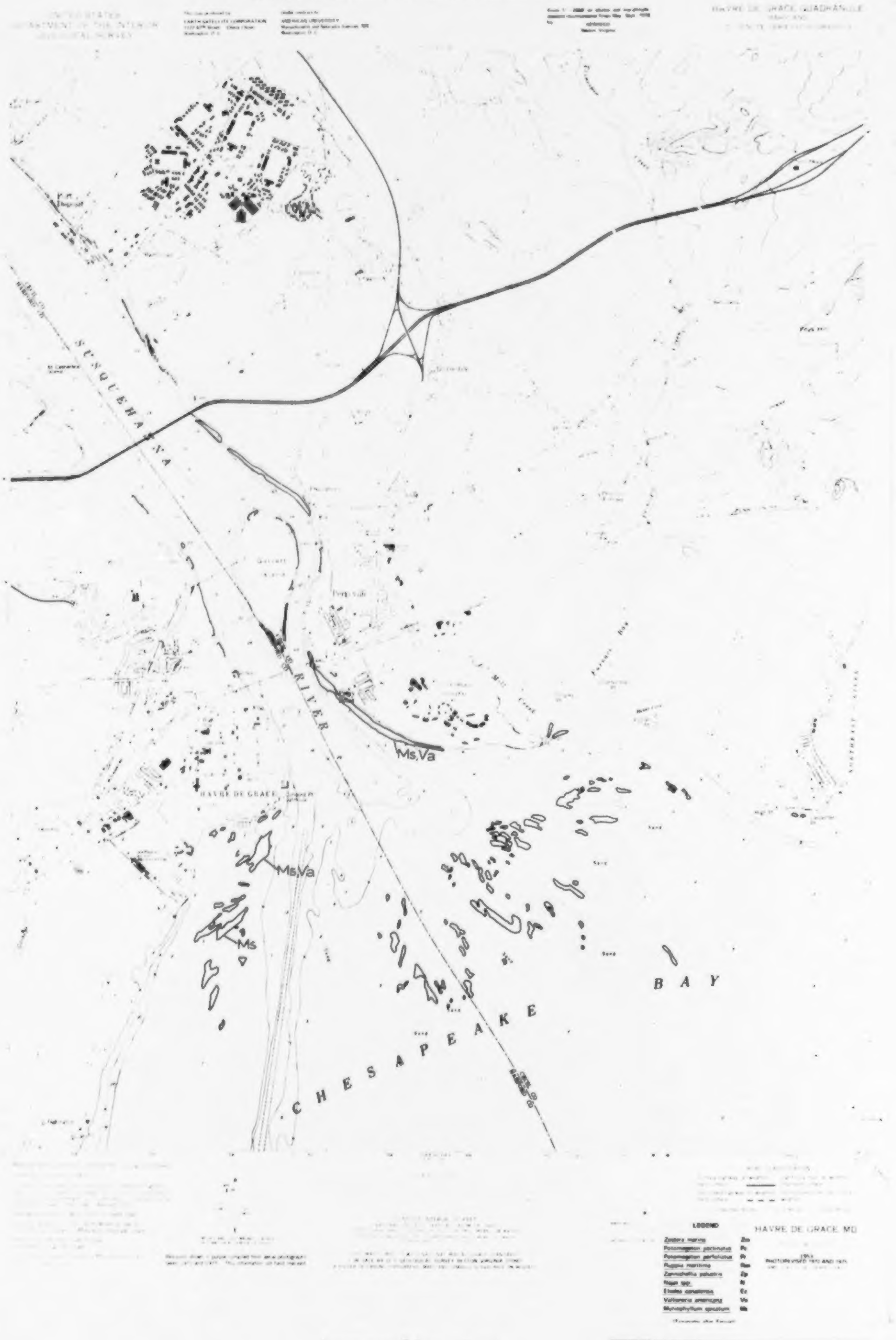
ARCHIVAL PHOTOGRAPHY USED FOR THE DISTRIBUTION AND ABUNDANCE STUDY OF SAV IN THE SENECA/SALT PETER CREEK AREA

Source	Roll/Frame	Date
USDA:SCS	AJO-4K/06	7/12/52
	AJO-4K/07	
	AJO-4K/08	
	AJO-4K/193	
	AJO-4T/60	9/25/57
	AJO-4T/61	
	AJO-4T/62	
	AJO-4T/63	
	AJO-4T/04	
	AJO-4MM/134	10/11/71
	AJO-4MM/135	
	AJO-4MM/136	
	AJO-5MM/32	
	AJO-5MM/33	
NOAA	9691A	8/9/60
	9692A	
	9504	9/25/71
NASA	623900520/77	6/14/73
USGS	B59035/2110	6/15/59

APPENDIX G

Photographic Reproduction of U.S. Geological Topographic Quadrangles which contained mappable submersed aquatic vegetation.

SUBMERSED AQUATIC VEGETATION DISTRIBUTION – 1978


UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
EARTH SATELLITE CORPORATION
AMERICAN UNIVERSITY
HAVRE DE GRACE QUADRANGLE
MARYLAND
SUSQUEHANNA
RIVER
Perryville
HAVRE DE GRACE
Ms,Va
Ms,Va
Ms
CHESAPEAKE
BAY
LEGEND
Zostera marina Zm
Potamogeton pectinatus Pc
Potamogeton perfoliatus Pr
Ruppia maritima Rm
Zannichellia palustris Zp
Najas spp. N
Elodea canadensis Ec
Vallisneria americana Va
Myriophyllum spicatum Ms
HAVRE DE GRACE MD
PHOTOREVISED 1970 AND 1975

Appendix G-1

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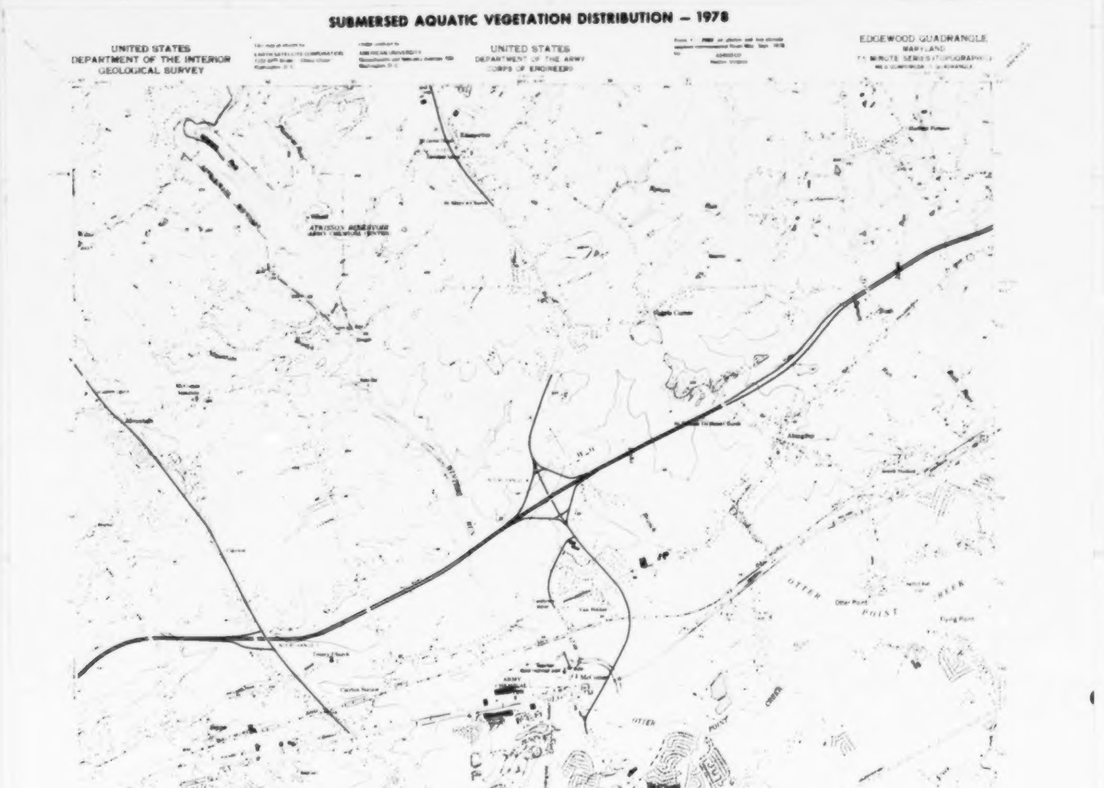
SUBMERSED AQUATIC VEGETATION DISTRIBUTION – 1978
UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
NORTH EAST QUADRANGLE
MARYLAND–CECIL COUNTY
7.5 MINUTE SERIES (TOPOGRAPHIC)
ELK NECK
STATE FOREST
NORTHEAST RIVER
Ms
Ms
Va,Ms
NECK
CHESAPEAKE BAY
ELK RIVER
ELK
Town Point
FOR SALE BY U.S. GEOLOGICAL SURVEY WASHINGTON D.C. 20242
LEGEND
Zostera marina Zm
Potamogeton perfoliatus Pp
Potamogeton pectinatus Pe
Ruppia maritima Rm
Zannichellia palustris Zp
Najas sp. N
Elodea canadensis Ec
Vallisneria americana Va
Myriophyllum spicatum Ms
(Taxonomy after Fernald)
NORTH EAST, MD

Appendix G-2

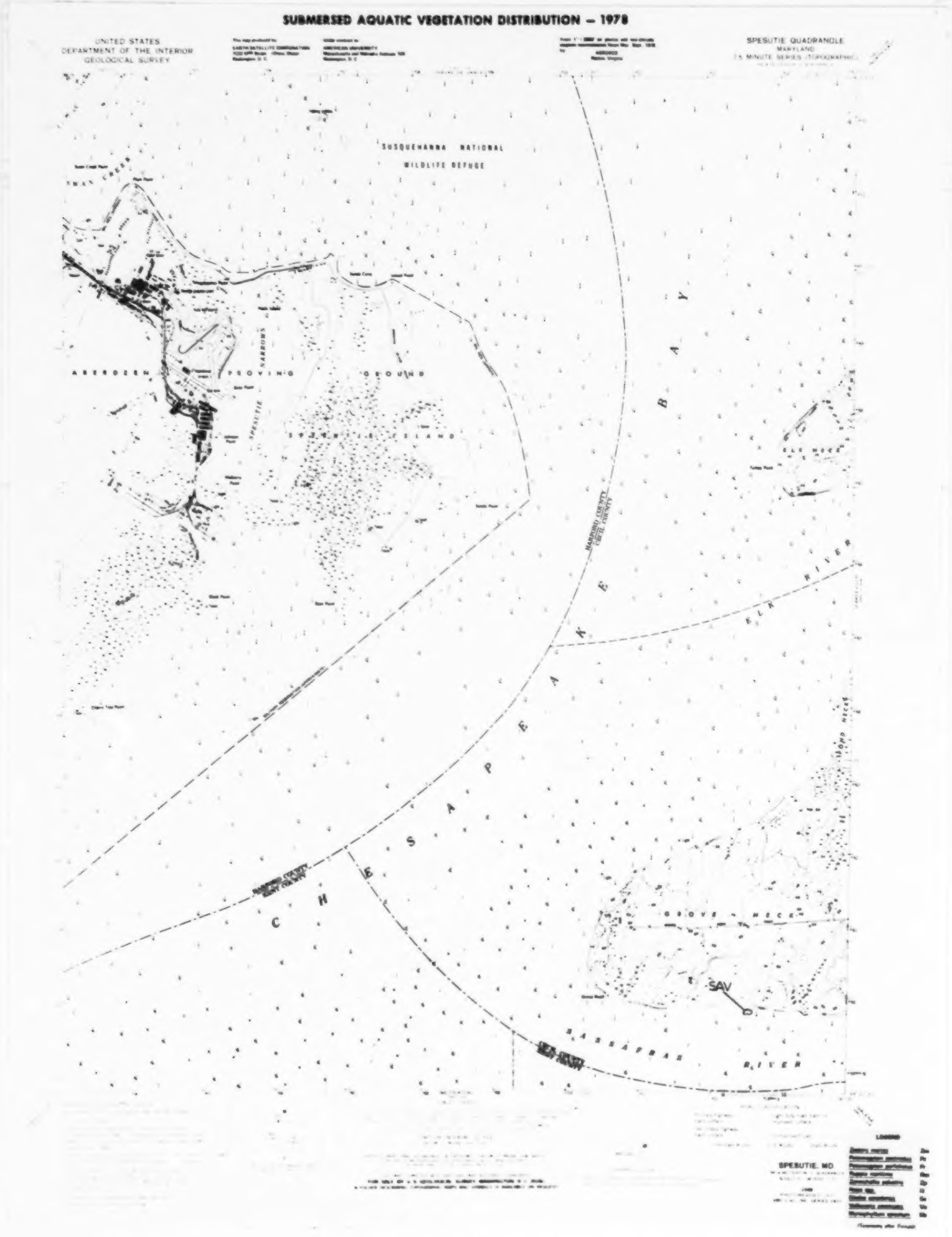
SUBMERSED AQUATIC VEGETATION DISTRIBUTION – 1978
UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
ELKTON QUADRANGLE
MARYLAND - DELAWARE
7.5 MINUTE SERIES (TOPOGRAPHIC)
ELKTON
ELK RIVER
BACK CREEK
SAV
DISTRICT NO 11
ELKTON MD DEL
1953
LEGEND
Zostera marina Zm
Potamogeton pectinatus Pp
Potamogeton perfoliatus Pr
Ruppia maritima Rm
Zannichellia palustris Zp
Najas spp. N
Elodea canadensis Ec
Vallisneria americana Va
Myriophyllum spicatum Ms
(Taxonomy after Fernald)
FOR SALE BY U.S. GEOLOGICAL SURVEY WASHINGTON D.C. 20242

Appendix G-3

Reproduced from
best available copy.


SUBMERSED AQUATIC VEGETATION DISTRIBUTION – 1978
UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
UNITED STATES
DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
EDGEWOOD QUADRANGLE
MARYLAND
7.5 MINUTE SERIES (TOPOGRAPHIC)
ATKISSON RESERVOIR
OTTER POINT CREEK
Otter Point
Edgewood
ARMY CHEMICAL CENTER
ABERDEEN
PROVING
GROUND
Magnolia
GUNPOWDER
DAYS ISLAND
SAV
SAV
GUNPOWDER
RIVER
BIRD
RIVER
HARFORD
BALTIMORE
CO
CO
West Twin River
Harewood Park
Harewood
BUSH
RIVER
REDMAN
COVE
Rocky Jetty
Eagle Point
Taylor Point
Beach Point
LEGEND
Zostera marina Zm
Potamogeton pectinatus Pc
Potamogeton perfoliatus Pt
Ruppia maritima Rm
Zannichellia palustris Zp
Najas spp. N
Elodea canadensis Ec
Vallisneria americana Va
Myriophyllum spicatum Ms
EDGEWOOD MD
U.S. Route
State Route

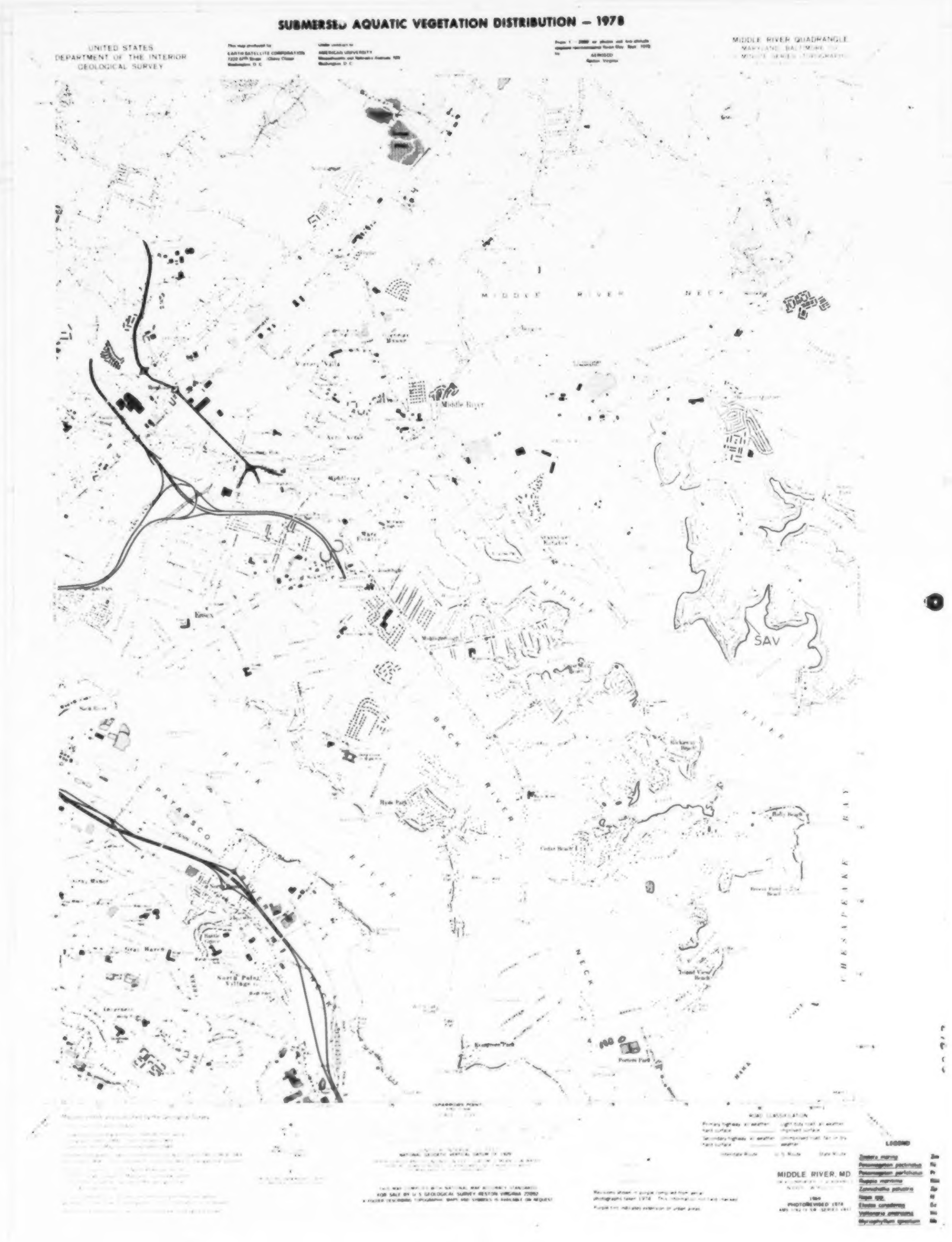
Appendix G-4


SUBMERSED AQUATIC VEGETATION DISTRIBUTION – 1978
UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
SPESUTIE QUADRANGLE
MARYLAND
7.5 MINUTE SERIES (TOPOGRAPHIC)
SUSQUEHANNA NATIONAL
WILDLIFE REFUGE
ABERDEEN PROVING GROUND
SPESUTIE NARROWS
SPESUTIE ISLAND
CHESAPEAKE BAY
HARFORD COUNTY
CECIL COUNTY
KENT COUNTY
ELK RIVER
GROVE NECK
SAV
SASSAFRAS RIVER
SPESUTIE, MD
LEGEND

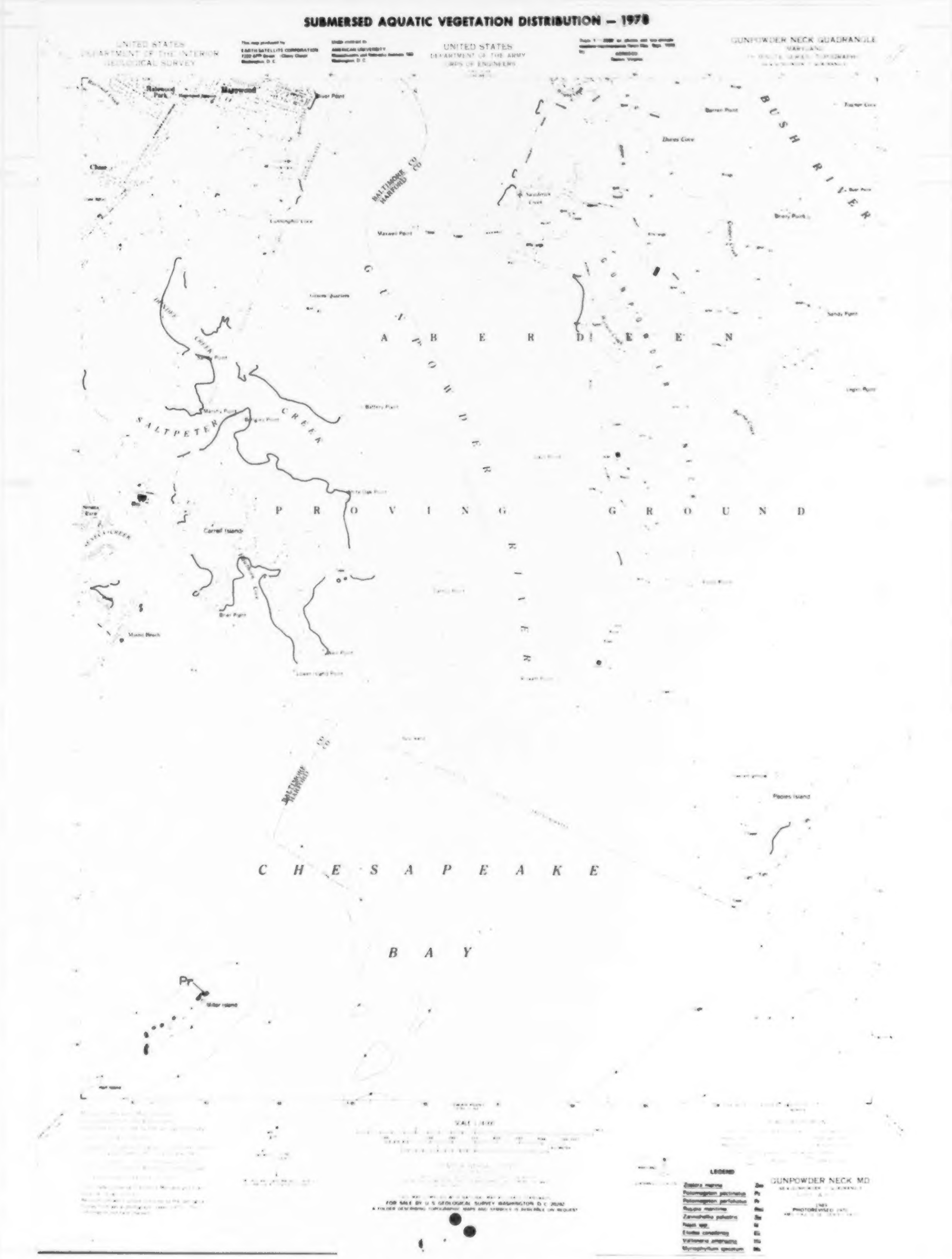
Appendix G-5

SUBMERSED AQUATIC VEGETATION DISTRIBUTION – 1978
UNITED STATES DEPARTMENT OF THE INTERIOR GEOLOGICAL SURVEY
UNITED STATES DEPARTMENT OF THE ARMY CORPS OF ENGINEERS
EARLEVILLE QUADRANGLE
TOWN POINT NECK
ELK RIVER
ELK NECK
CHESAPEAKE BAY
BOHEMIA RIVER
VEAZEY NECK
PEARCE NECK
Crystal Beach
POND NECK
SASSAFRAS NECK
GROVE NECK
SASSAFRAS RIVER
LEGEND
Zostera marina Zm
Potamogeton pectinatus Pp
Potamogeton perfoliatus Pr
Ruppia maritima Rm
Zannichellia palustris Zp
Najas spp. Ns
Elodea canadensis Ec
Vallisneria americana Va
Myriophyllum spicatum Ms
(Taxonomy after Fernald)
EARLEVILLE, MD.

Appendix G-6


SUBMERSED AQUATIC VEGETATION DISTRIBUTION – 1978
UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
EARTH SATELLITE CORPORATION
AMERICAN UNIVERSITY
MIDDLE RIVER QUADRANGLE
MARYLAND
MIDDLE RIVER NECK
Middle River
Essex
BACK RIVER
PATAPSCO RIVER
NECK
CHESAPEAKE BAY
SAV
ROAD CLASSIFICATION
Primary highway, all weather, hard surface
Light-duty road, all weather, improved surface
Secondary highway, all weather, hard surface
Unimproved road, fair or dry weather
Interstate Route
U.S. Route
State Route
MIDDLE RIVER, MD
PHOTOREVISED 1974
LEGEND
Zostera marina
Zm
Potamogeton pectinatus
Pp
Potamogeton perfoliatus
Pe
Ruppia maritima
Rm
Zannichellia palustris
Zp
Najas spp.
Nj
Elodea canadensis
Ec
Vallisneria americana
Va
Myriophyllum spicatum
Ms

Appendix G-7


SUBMERSED AQUATIC VEGETATION DISTRIBUTION – 1978
UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
UNITED STATES
DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
GUNPOWDER NECK QUADRANGLE
MARYLAND
Rockwood Park
Maxwell Point
BUSH RIVER
GUNPOWDER RIVER
ABERDEEN PROVING GROUND
SALTPETER CREEK
BALTIMORE CO
HARFORD CO
Carroll Island
Pooles Island
Miller Island
Pr
CHESAPEAKE BAY
FOR SALE BY U.S. GEOLOGICAL SURVEY WASHINGTON D.C. 20242
LEGEND
Zostera marina Zm
Potamogeton pectinatus Pp
Potamogeton perfoliatus Pe
Ruppia maritima Rm
Zannichellia palustris Zp
Najas spp. N
Elodea canadensis Ec
Vallisneria americana Va
Myriophyllum spicatum Ms
GUNPOWDER NECK MD
1965
PHOTOREVISED 1970

Appendix G-8

SUBMERSED AQUATIC VEGETATION DISTRIBUTION — 1978
MARYLAND
HANESVILLE
SHEET 5762 I SW
ABERDEEN PROVING GROUND
MILITARY RESERVATION
CHESAPEAKE BAY
Ms
LEGEND
HANESVILLE, MARYLAND

Appendix G-9

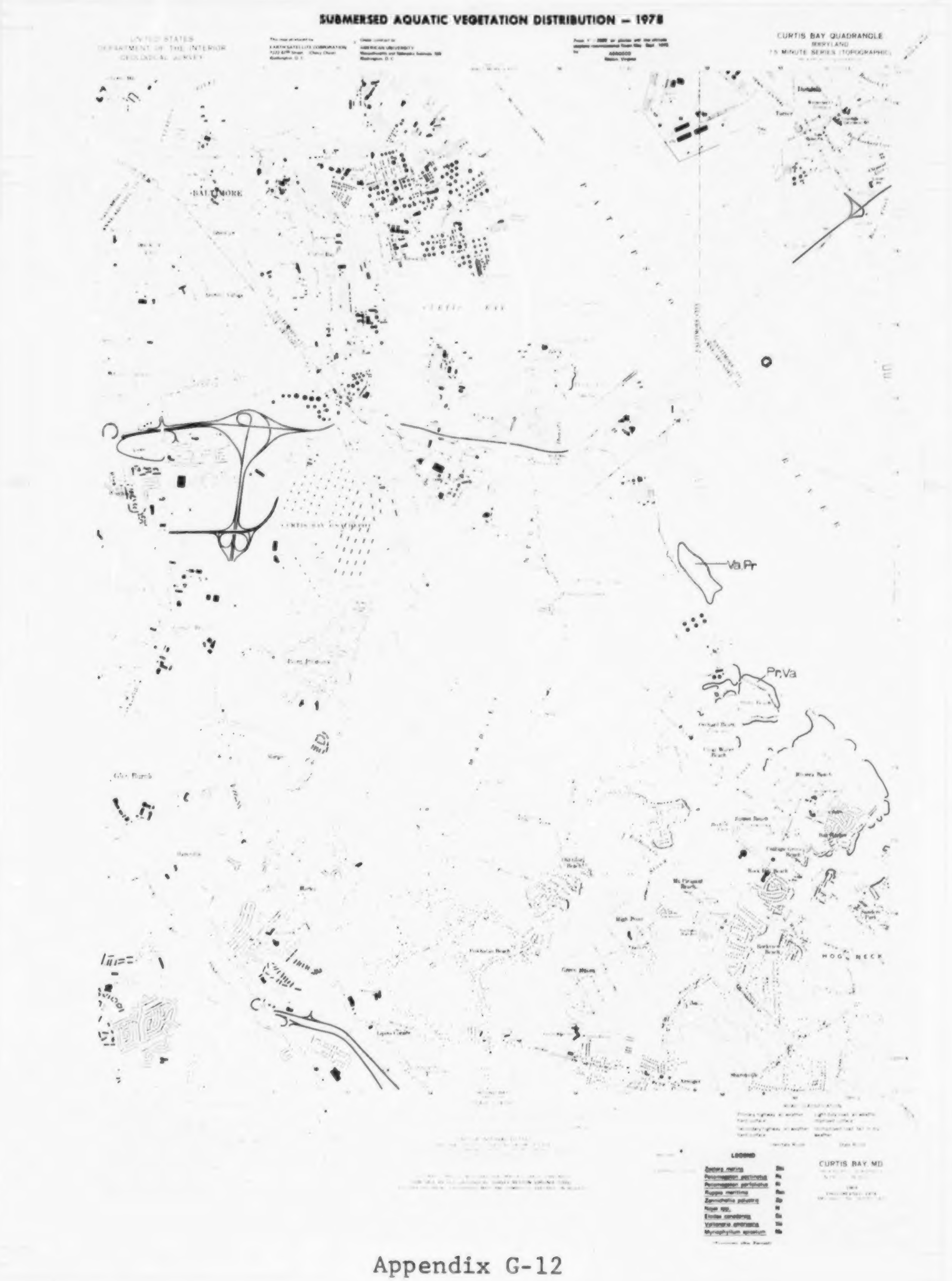
SUBMERSED AQUATIC VEGETATION DISTRIBUTION – 1978

MARYLAND
BETTERTON
SHEET 5762 I SE
SASSAFRAS
RIVER
CHESAPEAKE BAY
STILLPOND
NECK
Ms
CONTOUR INTERVAL 10 FEET
TRANSVERSE MERCATOR PROJECTION
LEGEND
LEGEND
Zostera marina Zm
Potamogeton perfoliatus Pp
Potamogeton pectinatus Pc
Ruppia maritima Rm
Zannichellia palustris Zp
Najas spp. N
Elodea canadensis Ec
Vallisneria americana Va
Myriophyllum spicatum Ms
(Taxonomy after Fernald)
FOR SALE BY U S GEOLOGICAL SURVEY RESTON VIRGINIA 22092
BETTERTON, MARYLAND
KENT COUNTY
N3915-W7600/7.5

Appendix G-10

SUBMERSED AQUATIC VEGETATION DISTRIBUTION – 1978
UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
UNITED STATES
DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
GALENA QUADRANGLE
MARYLAND
7.5 MINUTE SERIES (TOPOGRAPHIC)
SASSAFRAS
RIVER
SHELLCROSS
GALENA MD.
1953
LEGEND

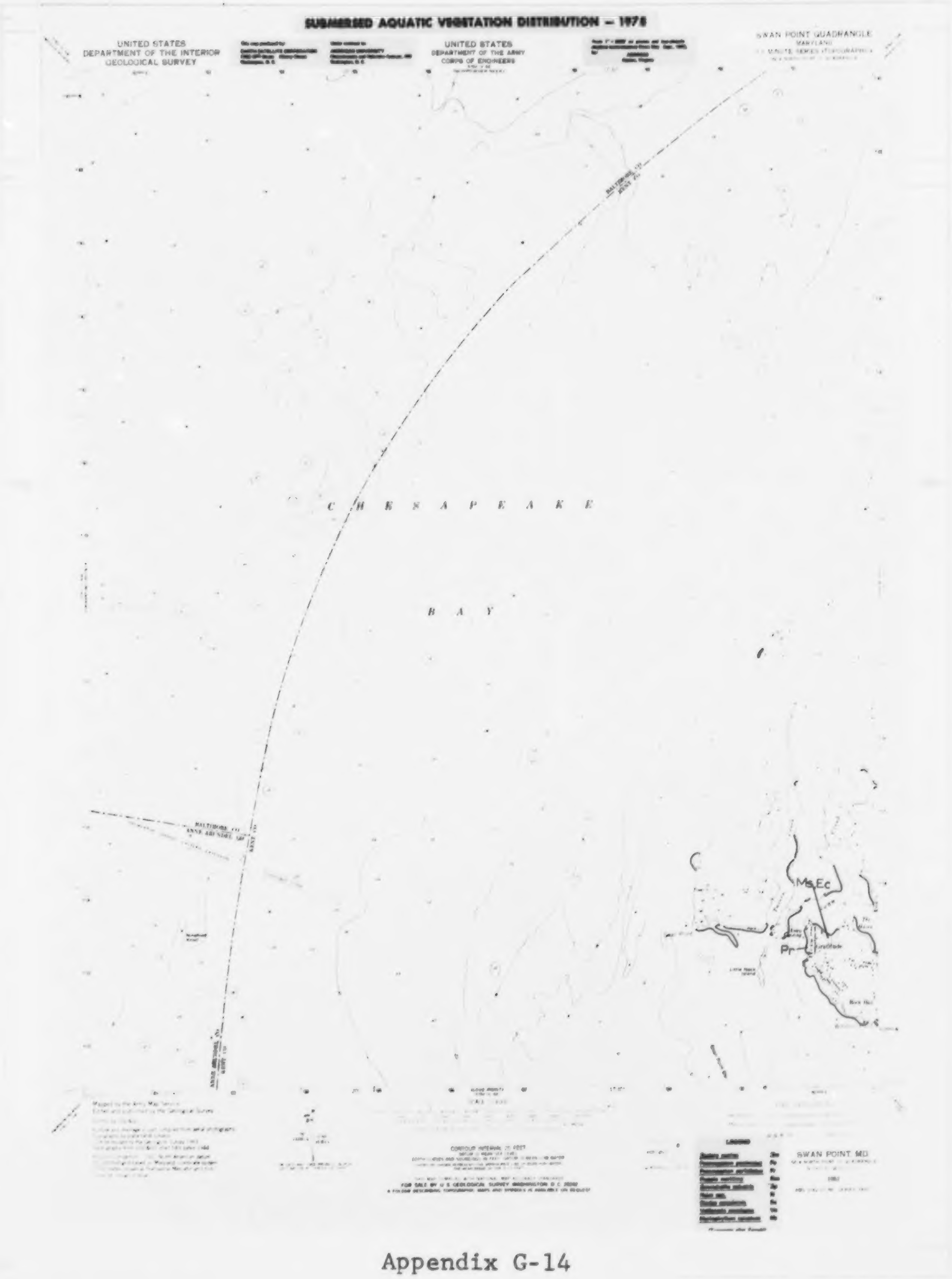
Appendix G-11


SUBMERSED AQUATIC VEGETATION DISTRIBUTION – 1978
UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
CURTIS BAY QUADRANGLE
MARYLAND
7.5 MINUTE SERIES (TOPOGRAPHIC)
BALTIMORE
Va,Pr
Pr,Va
HOG NECK
LEGEND
Zostera marina Zm
Potamogeton pectinatus Pp
Potamogeton perfoliatus Pr
Ruppia maritima Rm
Zannichellia palustris Zp
Najas spp. Ni
Elodea canadensis Ec
Vallisneria americana Va
Myriophyllum spicatum Ms
CURTIS BAY, MD

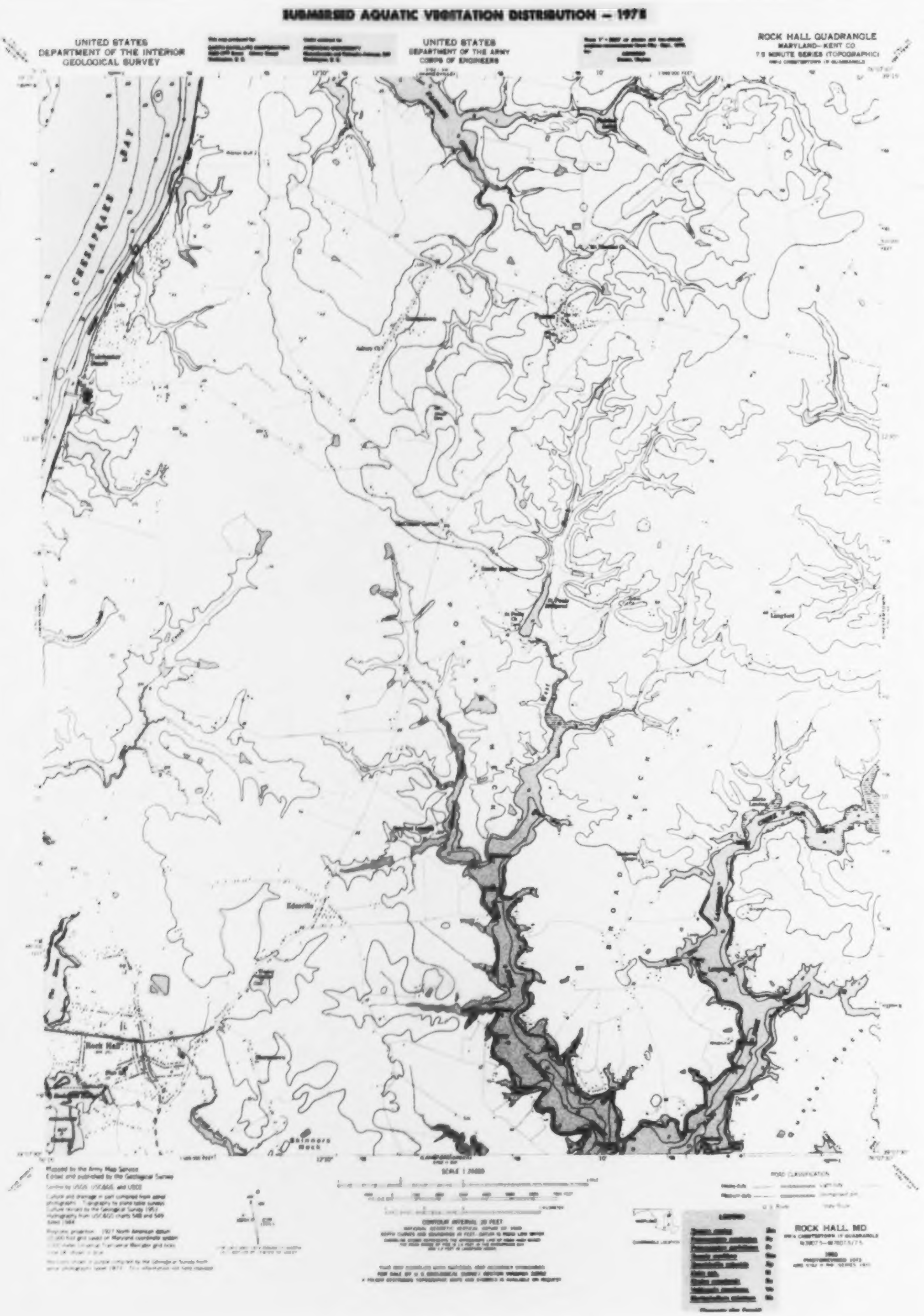
Appendix G-12

SUBMERSED AQUATIC VEGETATION DISTRIBUTION – 1978
UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
SPARROWS POINT QUADRANGLE
MARYLAND
7.5 MINUTE SERIES (TOPOGRAPHIC)
BACK
RIVER
HAWK COVE
Sparrows Point
NECK
Fort Howard
PATAPSCO
RIVER
CHESAPEAKE
BAY
HOG
NECK
Bayside Beach
LEGEND
Zostera marina Zm
Potamogeton pectinatus Pc
Potamogeton perfoliatus Pr
Ruppia maritima Rm
Zannichellia palustris Zp
Najas spp. N
Elodea canadensis Ec
Vallisneria americana Va
Myriophyllum spicatum Ms
(Taxonomy after Fernald)
SPARROWS POINT, MD.
PHOTOREVISED 1974

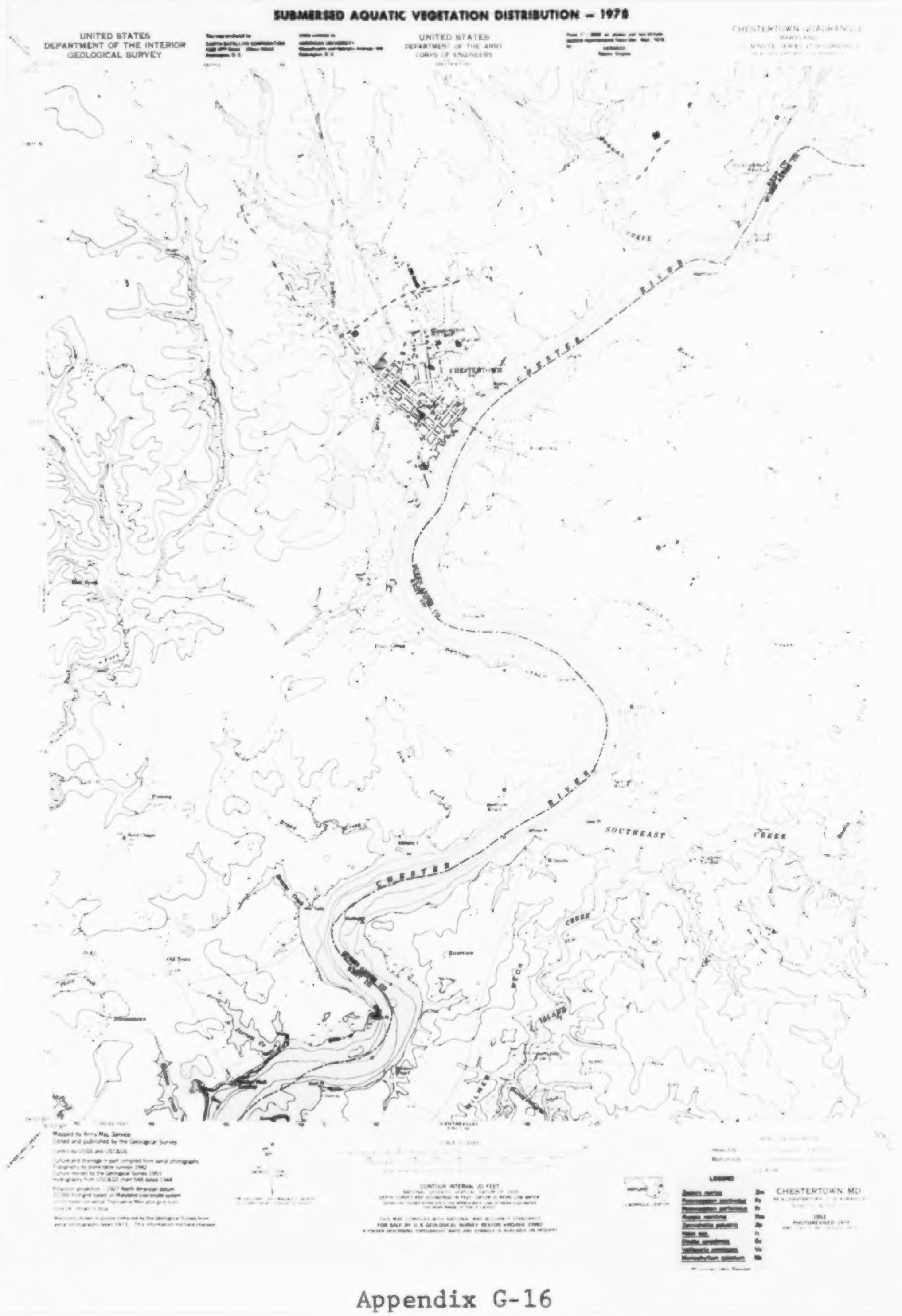
Appendix G-13


SUBMERSED AQUATIC VEGETATION DISTRIBUTION — 1978
UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
UNITED STATES
DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
SWAN POINT QUADRANGLE
MARYLAND
C H E S A P E A K E
B A Y
BALTIMORE CO
ANNE ARUNDEL CO
KENT CO
Ms,Ec
Pr
CONTOUR INTERVAL 20 FEET
FOR SALE BY U S GEOLOGICAL SURVEY WASHINGTON D C 20242
LEGEND
SWAN POINT, MD.

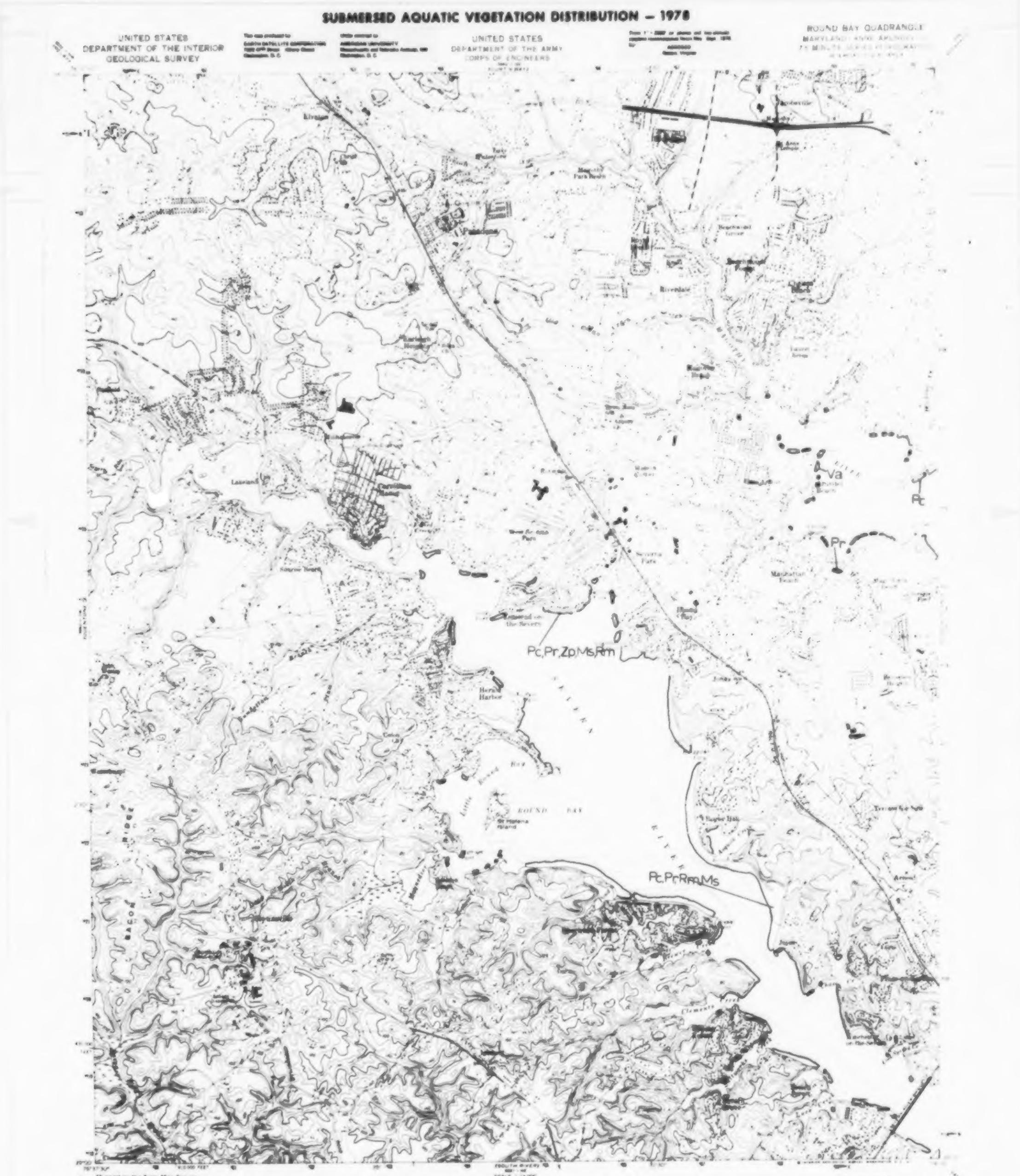
Appendix G-14


SUBMERSED AQUATIC VEGITATION DISTRIBUTION – 1978
UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
UNITED STATES
DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
ROCK HALL QUADRANGLE
MARYLAND–KENT CO
7.5 MINUTE SERIES (TOPOGRAPHIC)
CHESAPEAKE BAY
Rock Hall
Edesville
Skinners Neck
SCALE 1:24000
CONTOUR INTERVAL 20 FEET
ROAD CLASSIFICATION
U.S. Route
State Route
LEGEND
ROCK HALL MD

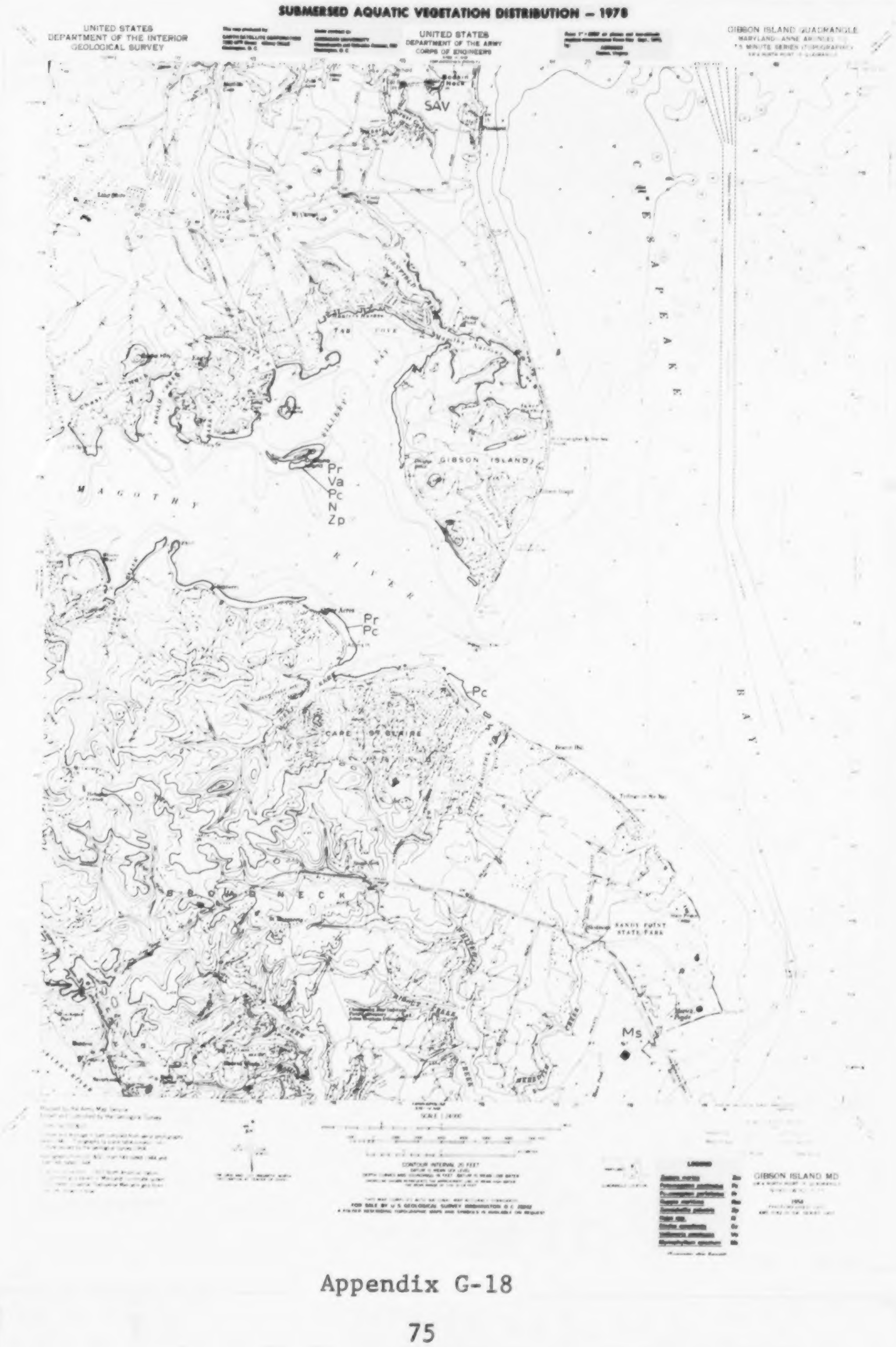
Appendix G-15


SUBMERSED AQUATIC VEGETATION DISTRIBUTION – 1978
UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
UNITED STATES
DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
CHESTERTOWN QUADRANGLE
MARYLAND
CHESTERTOWN
CHESTER RIVER
SOUTHEAST CREEK
CONTOUR INTERVAL 20 FEET
LEGEND
Zostera marina Zm
Potamogeton pectinatus Pp
Potamogeton perfoliatus Pf
Ruppia maritima Rm
Zannichellia palustris Zp
Najas sp. N
Elodea canadensis Ec
Vallisneria americana Va
Myriophyllum spicatum Ms
CHESTERTOWN, MD
1953
PHOTOREVISED 1974

Appendix G-16


SUBMERSED AQUATIC VEGETATION DISTRIBUTION – 1978
UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
UNITED STATES
DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
ROUND BAY QUADRANGLE
Va
Pc
Pr
Pc,Pr,Zp,Ms,Rm
Pc,Pr,Rm,Ms
SCALE 1:24 000
CONTOUR INTERVAL 20 FEET
ROUND BAY, MD
P

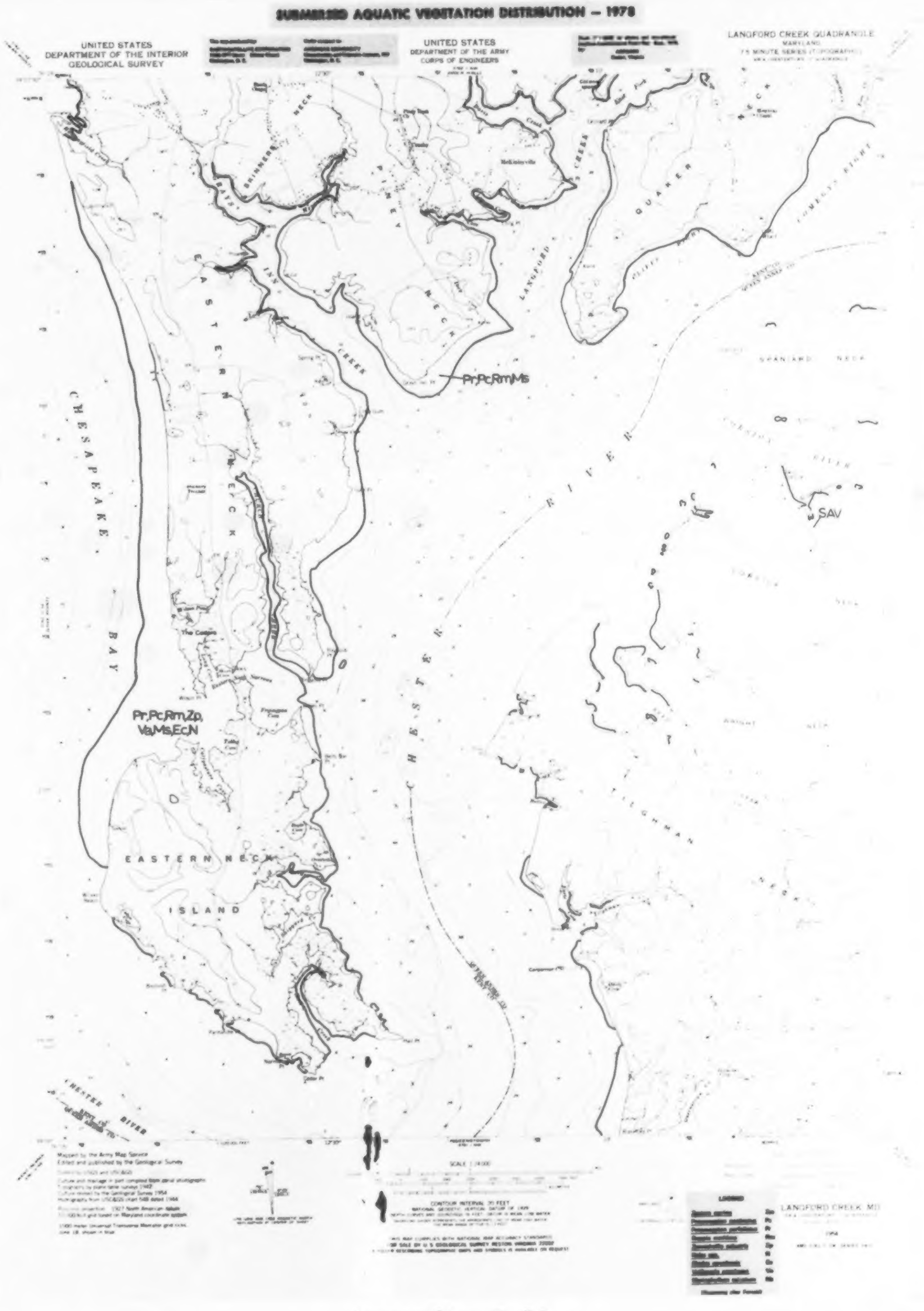
Appendix G-17


SUBMERSED AQUATIC VEGETATION DISTRIBUTION – 1978
UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
UNITED STATES
DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
GIBSON ISLAND QUADRANGLE
MARYLAND–ANNE ARUNDEL CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)
SAV
Pr
Va
Pc
N
Zp
MAGOTHY
RIVER
GIBSON ISLAND
CHESAPEAKE
BAY
Pr
Pc
Pc
CAPE ST. CLAIRE
BROADNECK
SANDY POINT STATE PARK
Ms
CONTOUR INTERVAL 20 FEET
FOR SALE BY U.S. GEOLOGICAL SURVEY, WASHINGTON, D.C. 20242
LEGEND
GIBSON ISLAND, MD.

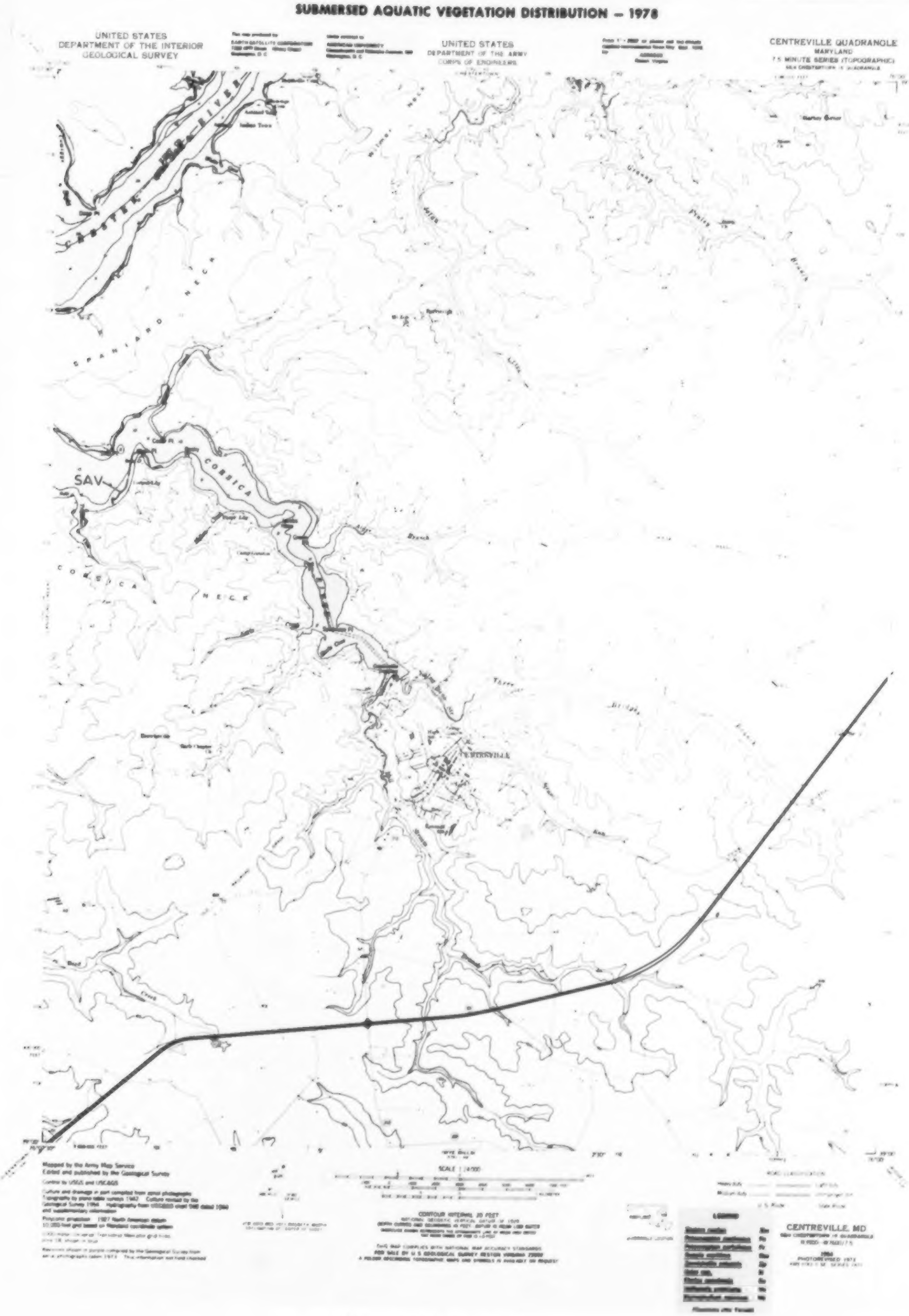
Appendix G-18

SUBMERSED AQUATIC VEGETATION DISTRIBUTION — 1978
UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
UNITED STATES
DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
LOVE POINT QUADRANGLE
MARYLAND
7.5 MINUTE SERIES (TOPOGRAPHIC)
ANNE ARUNDEL CO.
KENT CO.
QUEEN ANNES CO.
CHESAPEAKE BAY
KENT ISLAND
CHESTER RIVER
SCALE 1:24000
CONTOUR INTERVAL 20 FEET
LEGEND
LOVE POINT, MD.
1953
Love Pt

Appendix G-19


SUBMERSED AQUATIC VEGETATION DISTRIBUTION – 1978
UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
UNITED STATES
DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
LANGFORD CREEK QUADRANGLE
MARYLAND
7.5 MINUTE SERIES (TOPOGRAPHIC)
Pr,Pc,Rm,Ms
CHESAPEAKE BAY
EASTERN NECK
CHESTER RIVER
SAV
Pr,Pc,Rm,Zp,
Va,Ms,Ec,N
EASTERN NECK ISLAND
CONTOUR INTERVAL 20 FEET
LEGEND
LANGFORD CREEK, MD
1954

Appendix G-20


SUBMERSED AQUATIC VEGETATION DISTRIBUTION – 1978
UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
UNITED STATES
DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
CENTREVILLE QUADRANGLE
MARYLAND
7.5 MINUTE SERIES (TOPOGRAPHIC)
CHESTER RIVER
SPANIARD NECK
CORSICA
CORSICA NECK
SAV
CENTREVILLE
CONTOUR INTERVAL 20 FEET
CENTREVILLE, MD
1944
PHOTOREVISED 1973

Appendix G-21

SUBMERSED AQUATIC VEGETATION DISTRIBUTION – 1978
UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
UNITED STATES
DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
SOUTH RIVER QUADRANGLE
MARYLAND–ANNE ARUNDEL CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)
ANNAPOLIS
SOUTH
RIVER
Pr
Zp
Glebe
Bay
Pr
RHODE
RIVER
Selby Beach
Edgewater
Mayo
SOUTH RIVER, MD.
PHOTOREVISED 1970
ROAD CLASSIFICATION
SCALE 1:24 000

Appendix G-22

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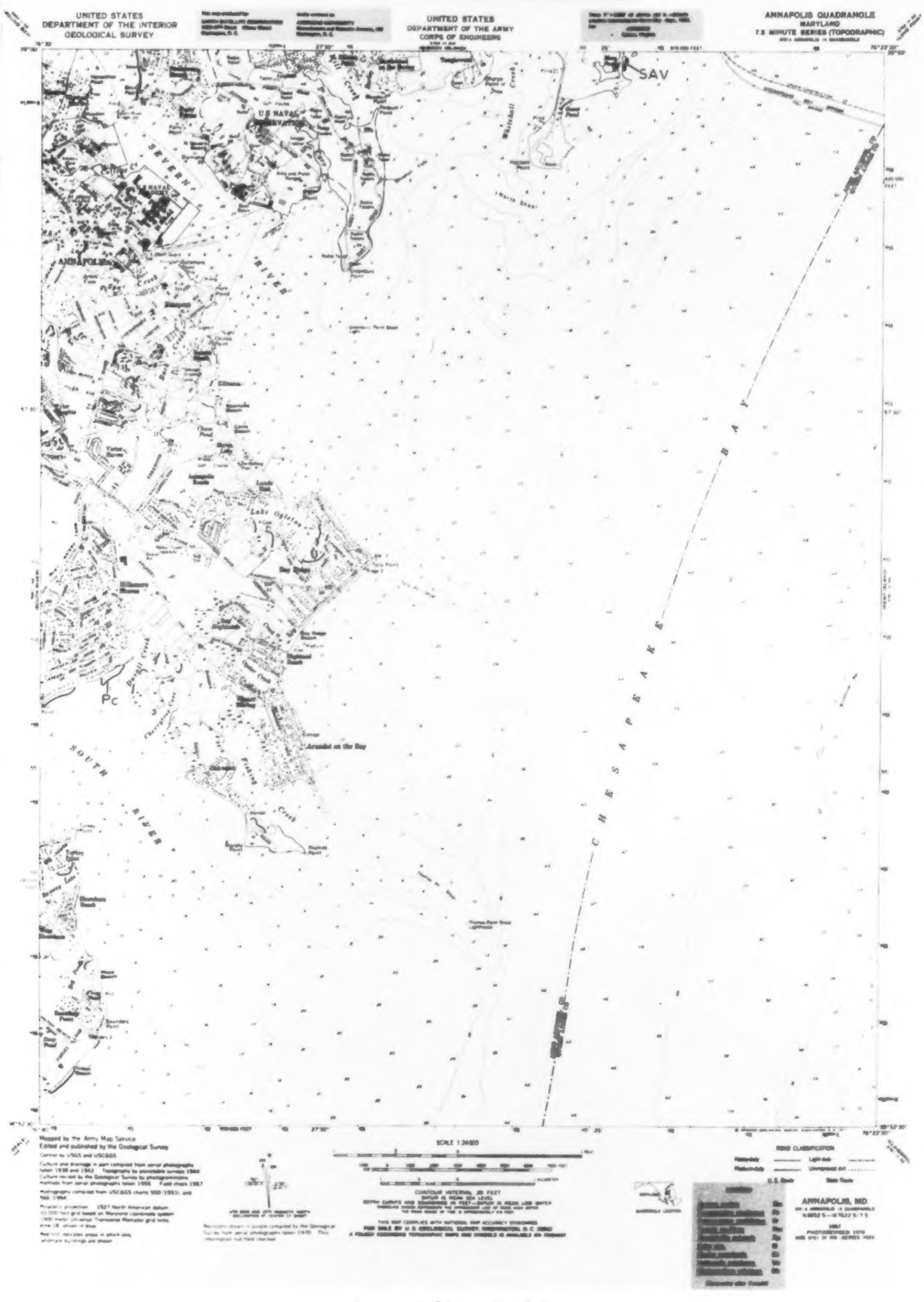
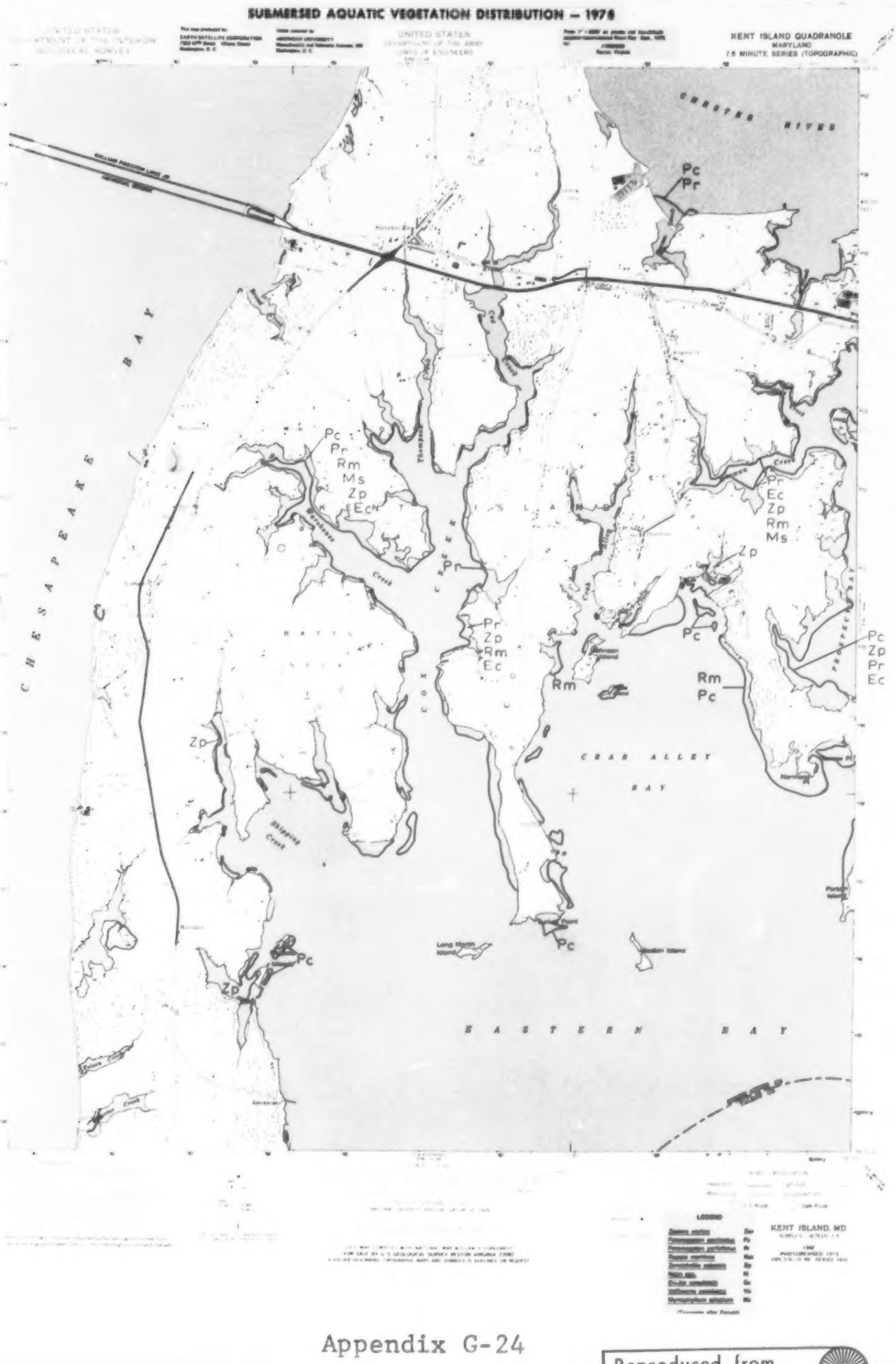
SUBMERSED AQUATIC VEGETATION DISTRIBUTION — 1978

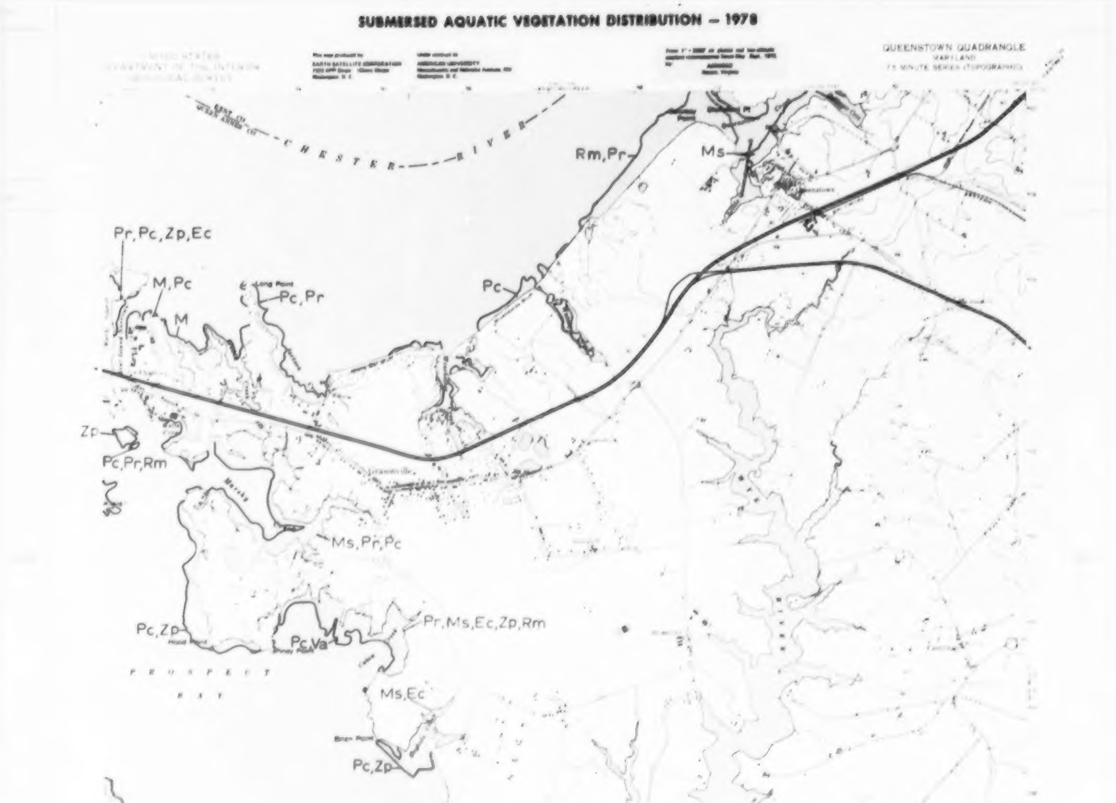

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
UNITED STATES
DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
ANNAPOLIS QUADRANGLE
MARYLAND
7.5 MINUTE SERIES (TOPOGRAPHIC)
SAV
Pc
ANNAPOLIS
U S NAVAL ACADEMY
SEVERN RIVER
Lake Ogleton
Arundel on the Bay
SOUTH RIVER
CHESAPEAKE BAY
Thomas Point Shoal Lighthouse
SCALE 1:24000
CONTOUR INTERVAL 20 FEET
ANNAPOLIS, MD.

Appendix G-23

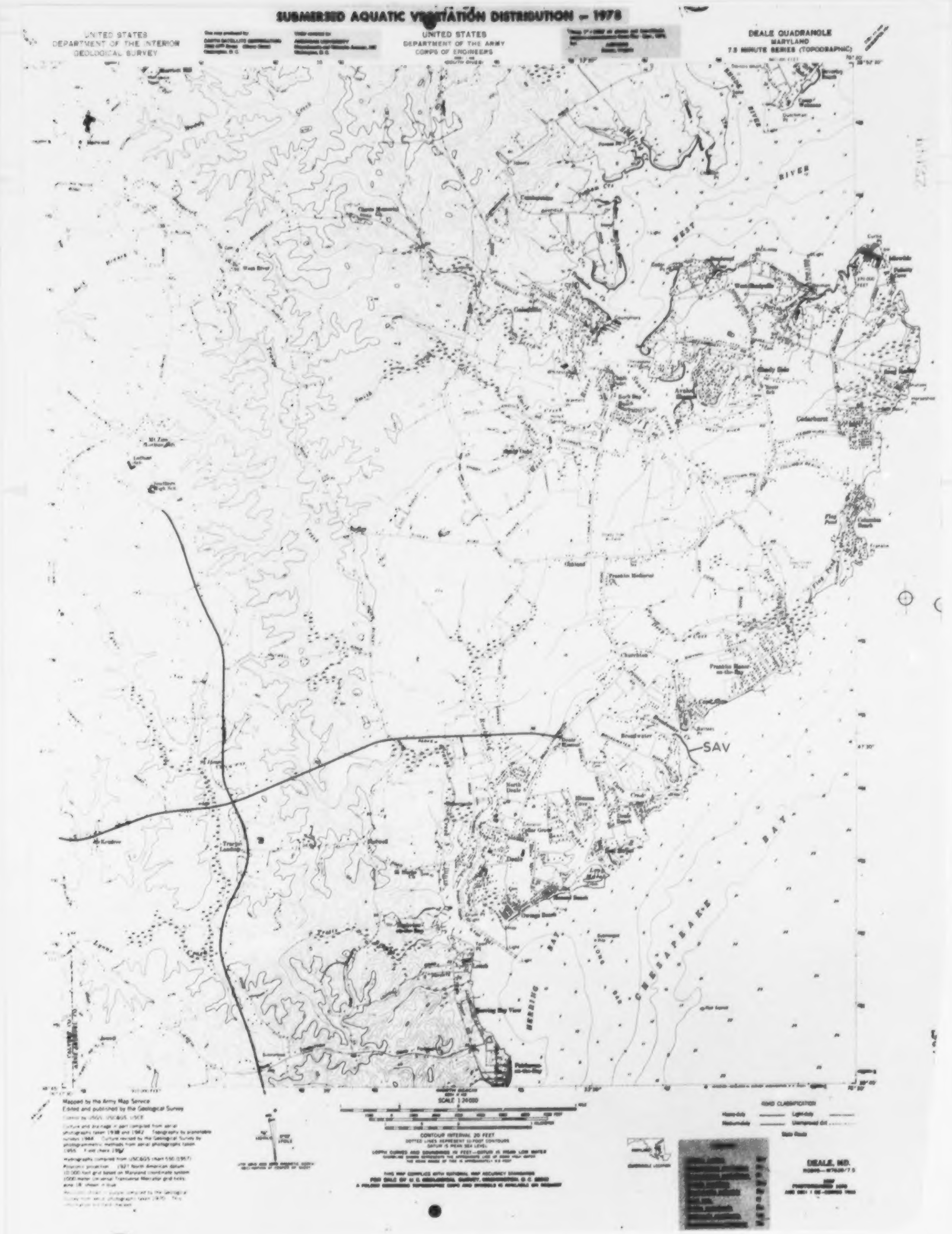

SUBMERSED AQUATIC VEGETATION DISTRIBUTION — 1978
UNITED STATES DEPARTMENT OF THE INTERIOR GEOLOGICAL SURVEY
UNITED STATES DEPARTMENT OF THE ARMY CORPS OF ENGINEERS
KENT ISLAND QUADRANGLE
MARYLAND
7.5 MINUTE SERIES (TOPOGRAPHIC)
CHESTER RIVER
CHESAPEAKE BAY
CRAB ALLEY BAY
EASTERN BAY
Pc Pr
Pc Pr Rm Ms Zp Ec
Pr
Pr Ec Zp Rm Ms
Zp
Pr Zp Rm Ec
Pc
Pc Zp Pr Ec
Rm Pc
Rm
Zp
Pc
Zp
Pc
LEGEND
KENT ISLAND, MD
PHOTOREVISED 1972

Appendix G-24

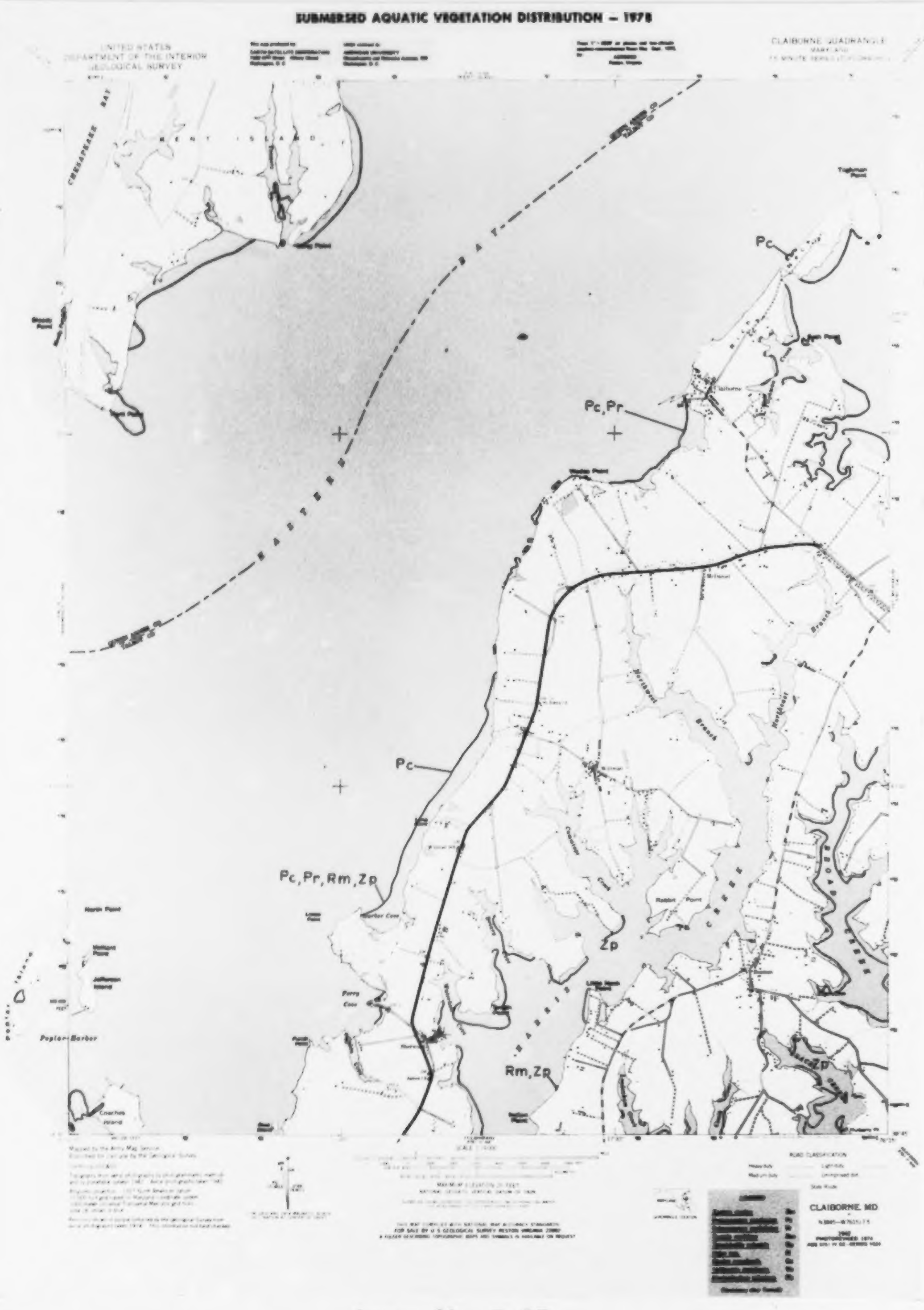
Reproduced from best available copy.


SUBMERSED AQUATIC VEGETATION DISTRIBUTION – 1978
QUEENSTOWN QUADRANGLE
MARYLAND
7.5 MINUTE SERIES (TOPOGRAPHIC)
CHESTER RIVER
Rm,Pr
Ms
Pr,Pc,Zp,Ec
M,Pc
M
Pc,Pr
Pc
Zp
Pc,Pr,Rm
Ms,Pr,Pc
Pc,Zp
Pc,Va
Pr,Ms,Ec,Zp,Rm
PROSPECT BAY
Ms,Ec
Pc,Zp
Pc,Zp
EASTERN BAY
WYE NARROWS
Rm,Zp
WYE RIVER
Zp
LEGEND
QUEENSTOWN MD

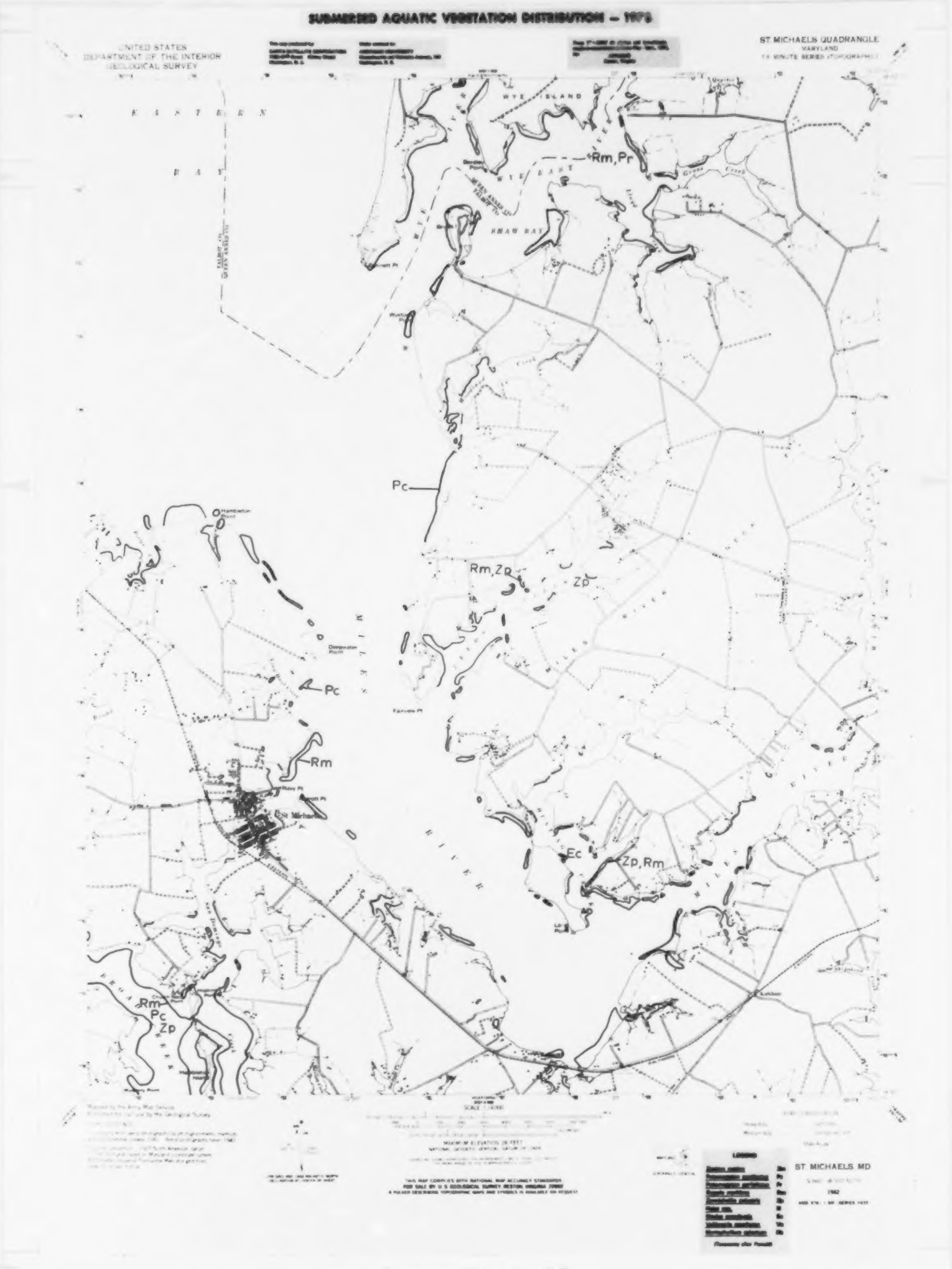
Appendix G-25


SUBMERSED AQUATIC VEGETATION DISTRIBUTION – 1978
UNITED STATES DEPARTMENT OF THE INTERIOR GEOLOGICAL SURVEY
UNITED STATES DEPARTMENT OF THE ARMY CORPS OF ENGINEERS
DEALE QUADRANGLE MARYLAND 7.5 MINUTE SERIES (TOPOGRAPHIC)
WEST RIVER
SAV
CHESAPEAKE BAY
HERRING BAY
SCALE 1:24000
CONTOUR INTERVAL 20 FEET
DEALE, MD.

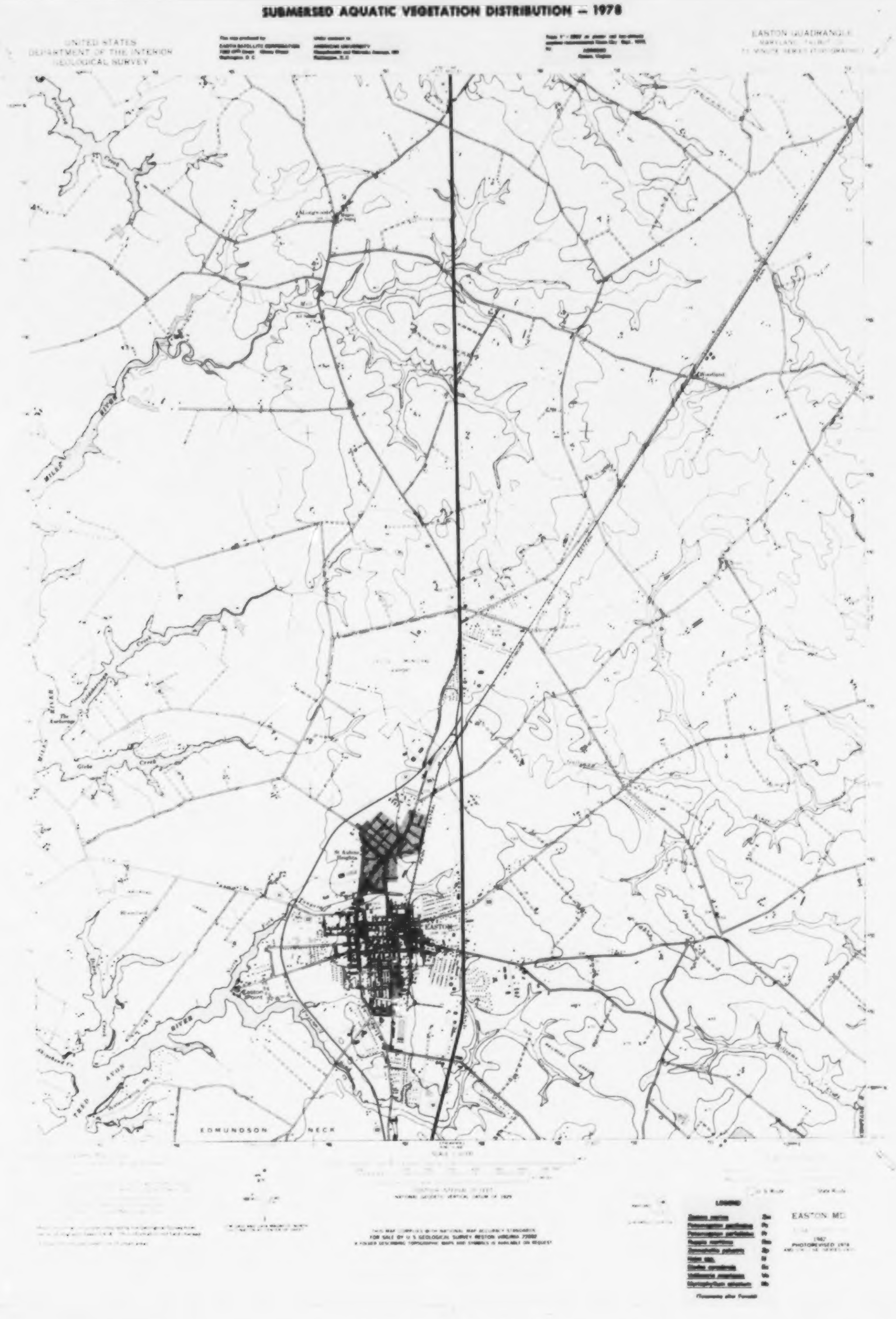
Appendix G-26


SUBMERSED AQUATIC VEGETATION DISTRIBUTION – 1978
UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
CLAIBORNE QUADRANGLE
MARYLAND
KENT ISLAND
CHESAPEAKE BAY
EASTERN BAY
Pc
Pc,Pr
Pc
Pc,Pr,Rm,Zp
Zp
Rm,Zp
Zp
Poplar Harbor
CLAIBORNE, MD

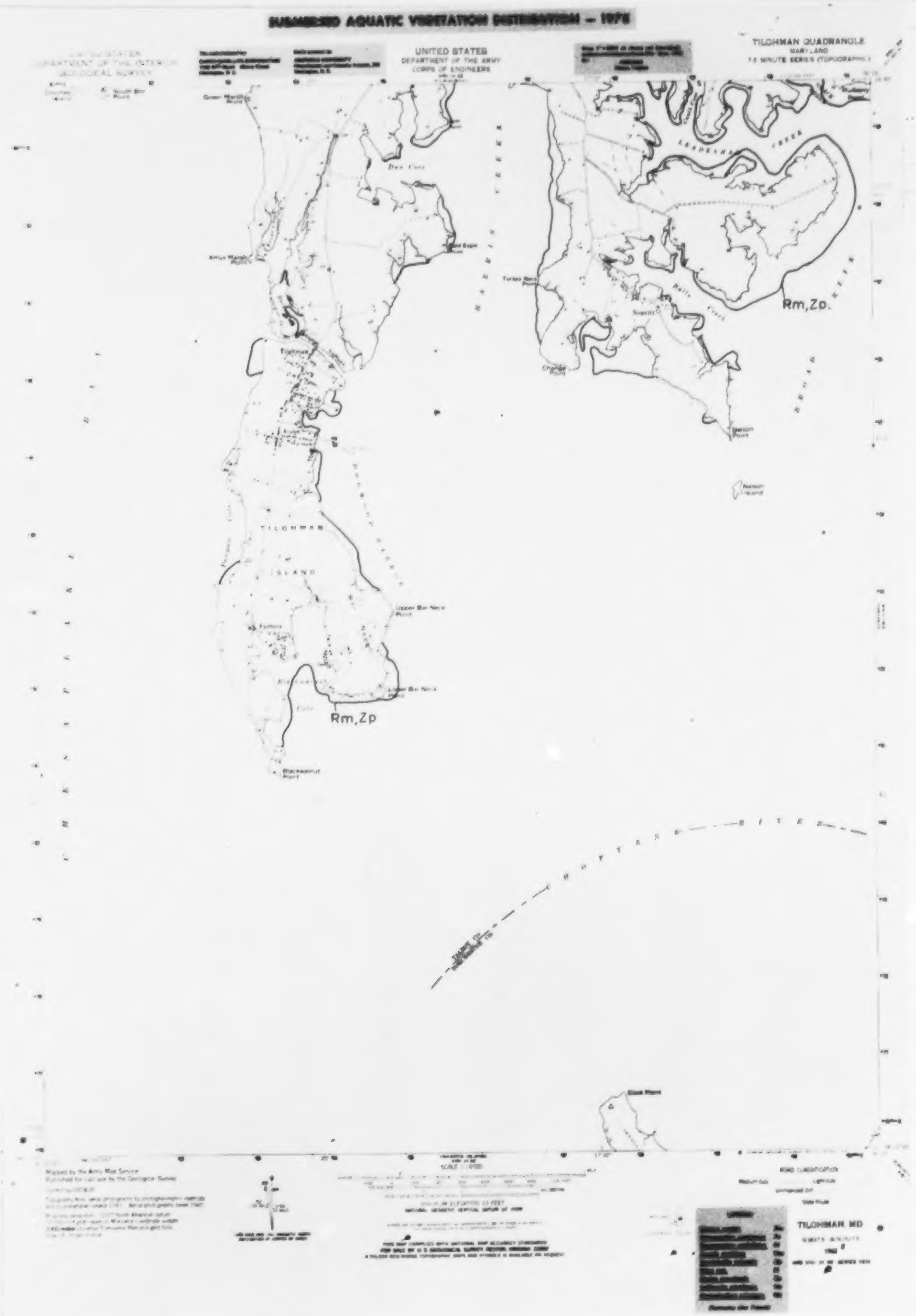
Appendix G-27


SUBMERGED AQUATIC VEGETATION DISTRIBUTION – 1978
UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
ST MICHAELS QUADRANGLE
MARYLAND
7.5 MINUTE SERIES (TOPOGRAPHIC)
EASTERN BAY
WYE ISLAND
SHAW BAY
Rm, Pr
Pc
Rm, Zp
Zp
Pc
Rm
Ec
Zp, Rm
Rm
Pc
Zp
MILES RIVER
LEGEND
ST MICHAELS, MD

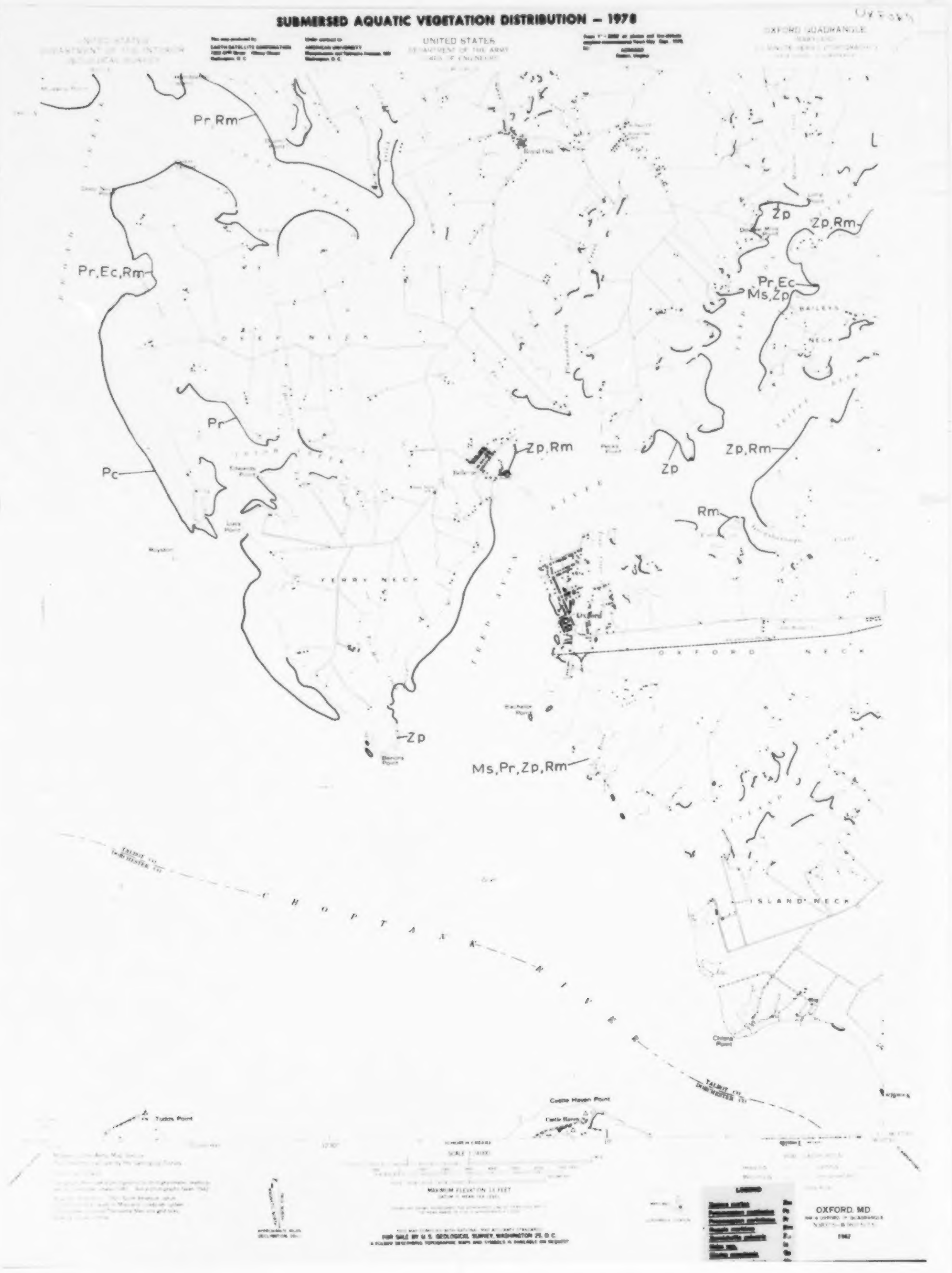
Appendix G-28


SUBMERSED AQUATIC VEGETATION DISTRIBUTION — 1978
UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
EASTON QUADRANGLE
MARYLAND–TALBOT CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)
EASTON
TRED AVON RIVER
EDMUNDSON NECK
LEGEND
Zostera marina
Potamogeton pectinatus
Potamogeton perfoliatus
Ruppia maritima
Zannichellia palustris
Najas sp.
Elodea canadensis
Vallisneria americana
Myriophyllum spicatum
Taxonomy after Fernald
EASTON, MD.
1967
PHOTOREVISED 1974

Appendix G-29


SUBMERGED AQUATIC VEGETATION DISTRIBUTION – 1978
UNITED STATES DEPARTMENT OF THE INTERIOR GEOLOGICAL SURVEY
UNITED STATES
DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
TILGHMAN QUADRANGLE
MARYLAND
7.5 MINUTE SERIES (TOPOGRAPHIC)
Dun Cove
HARRIS CREEK
LEADENHAM CREEK
Rm,Zp.
TILGHMAN
ISLAND
Upper Bar Neck Point
Rm,Zp
Blackwalnut Point
CHOPTANK RIVER
TILGHMAN MD

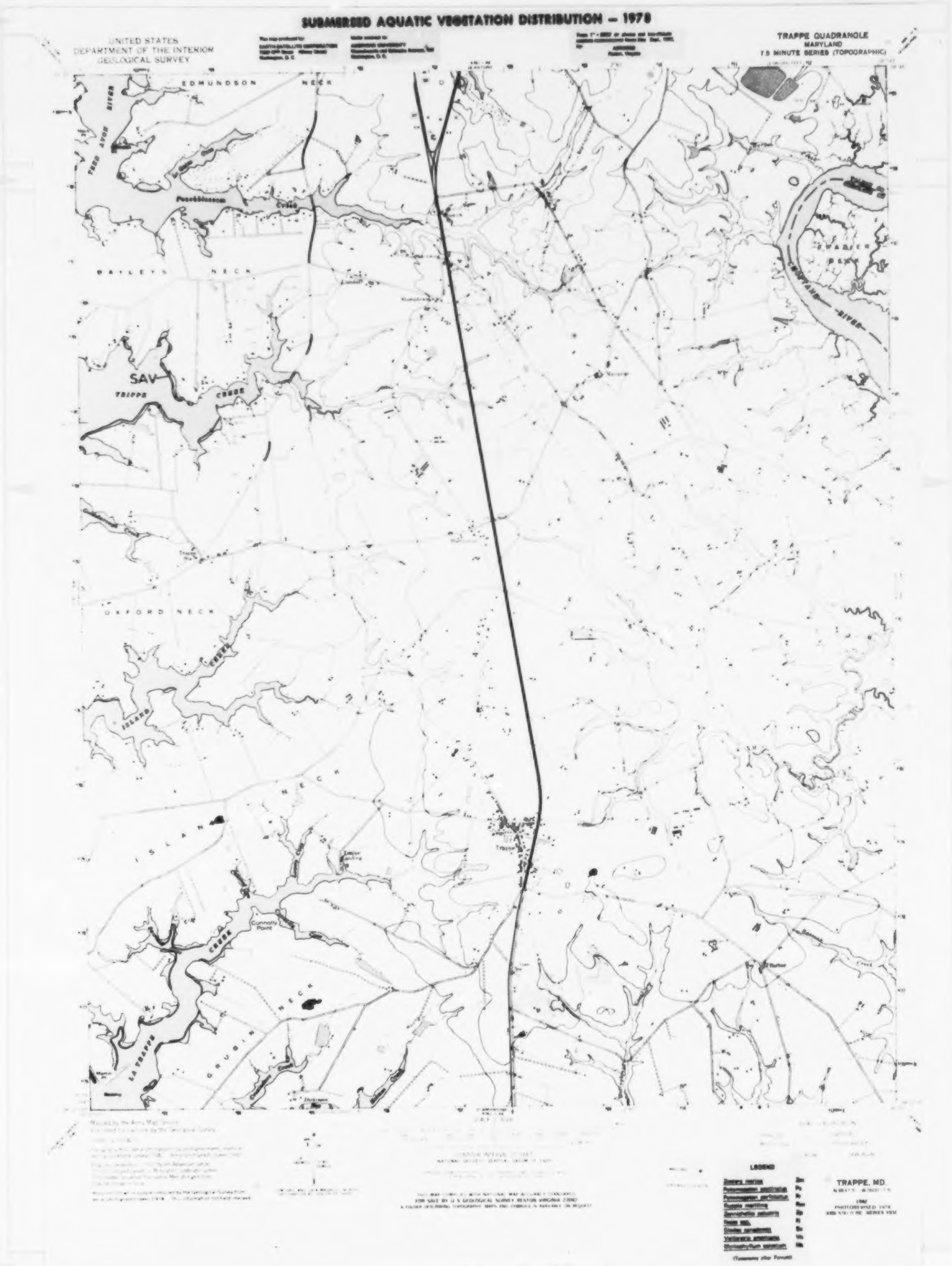
Appendix G-30



SUBMERSED AQUATIC VEGETATION DISTRIBUTION – 1978

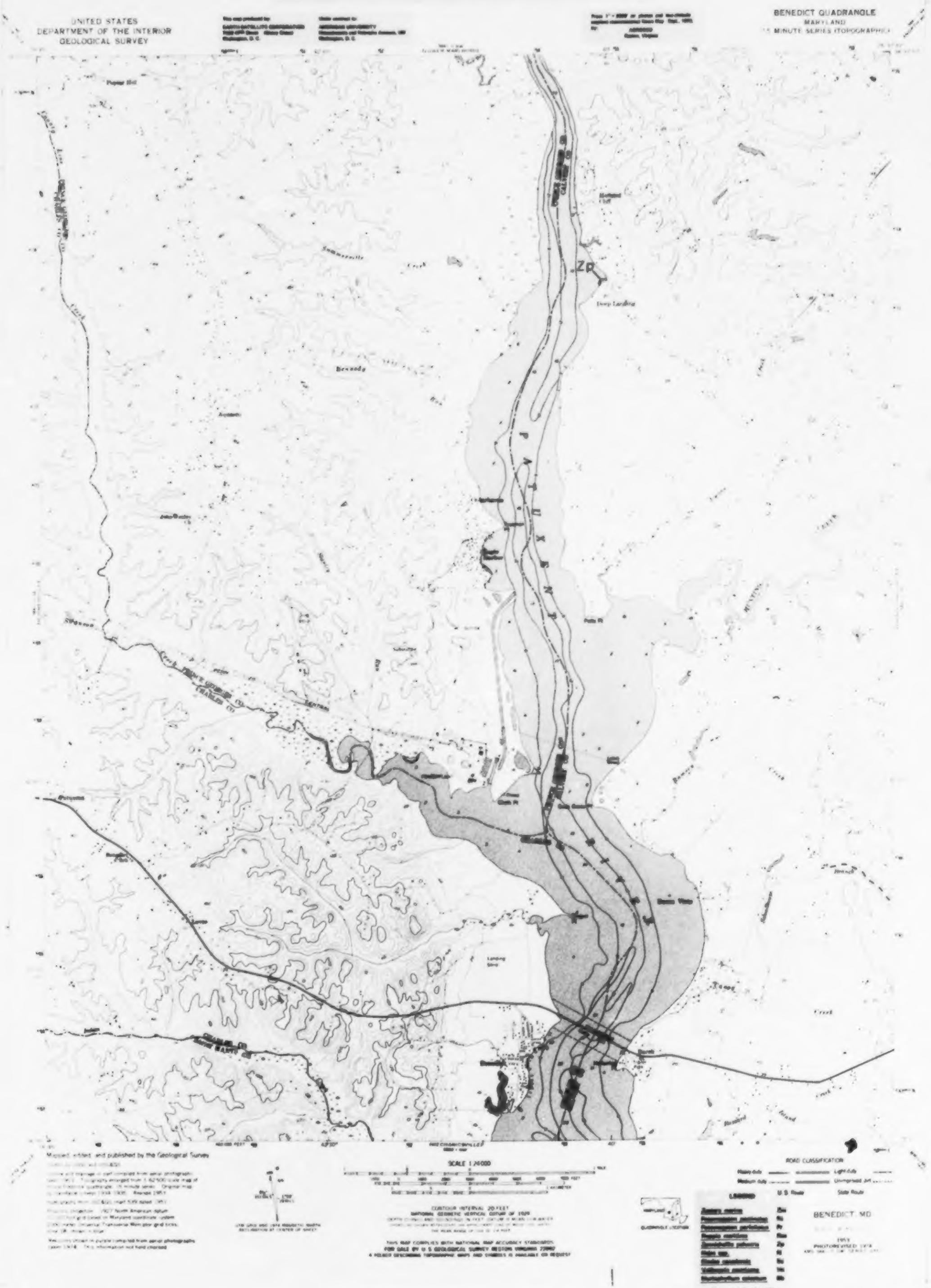
UNITED STATES
DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
OXFORD QUADRANGLE
Pr,Rm
Pr,Ec,Rm
Pr
Pc
Royal Oak
Zp
Zp,Rm
Pr,Ec
Ms,Zp
BAILEYS NECK
Zp,Rm
Zp
Zp,Rm
Rm
FERRY NECK
OXFORD NECK
Oxford
Zp
Ms,Pr,Zp,Rm
ISLAND NECK
CHOPTANK RIVER
TALBOT CO
DORCHESTER CO
Castle Haven Point
Todds Point
OXFORD, MD
1942

Appendix G-31


SUBMERSED AQUATIC VEGETATION DISTRIBUTION – 1978
UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
TRAPPE QUADRANGLE
MARYLAND
7.5 MINUTE SERIES (TOPOGRAPHIC)
EDMUNDSON
NECK
TRED AVON RIVER
Peachblossom
Creek
BAILEYS
NECK
SAV
TRIPPE
CREEK
OXFORD NECK
ISLAND
CREEK
NECK
ISLAND
Cummings Point
CREEK
LA TRAPPE
GRUBIN
NECK
CHOPTANK RIVER
Trappe
LEGEND
Zostera marina Zm
Potamogeton pectinatus Pp
Potamogeton perfoliatus Pe
Ruppia maritima Rm
Zannichellia palustris Zp
Najas sp. Nj
Elodea canadensis Ec
Vallisneria americana Va
Myriophyllum spicatum Ms
(Taxonomy after Fernald)
TRAPPE, MD.
1942
PHOTOREVISED 1974

Appendix G-32

SUBMERSED AQUATIC VEGETATION DISTRIBUTION – 1978


UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
BENEDICT QUADRANGLE
MARYLAND
7.5 MINUTE SERIES (TOPOGRAPHIC)
Deep Landing
ZP
Mapped, edited, and published by the Geological Survey
SCALE 1:24000
CONTOUR INTERVAL 20 FEET
ROAD CLASSIFICATION
Heavy duty
Light duty
Medium duty
Unimproved dirt
U.S. Route
State Route
LEGEND
QUADRANGLE LOCATION
MARYLAND
BENEDICT, MD.
1953
PHOTOREVISED 1978

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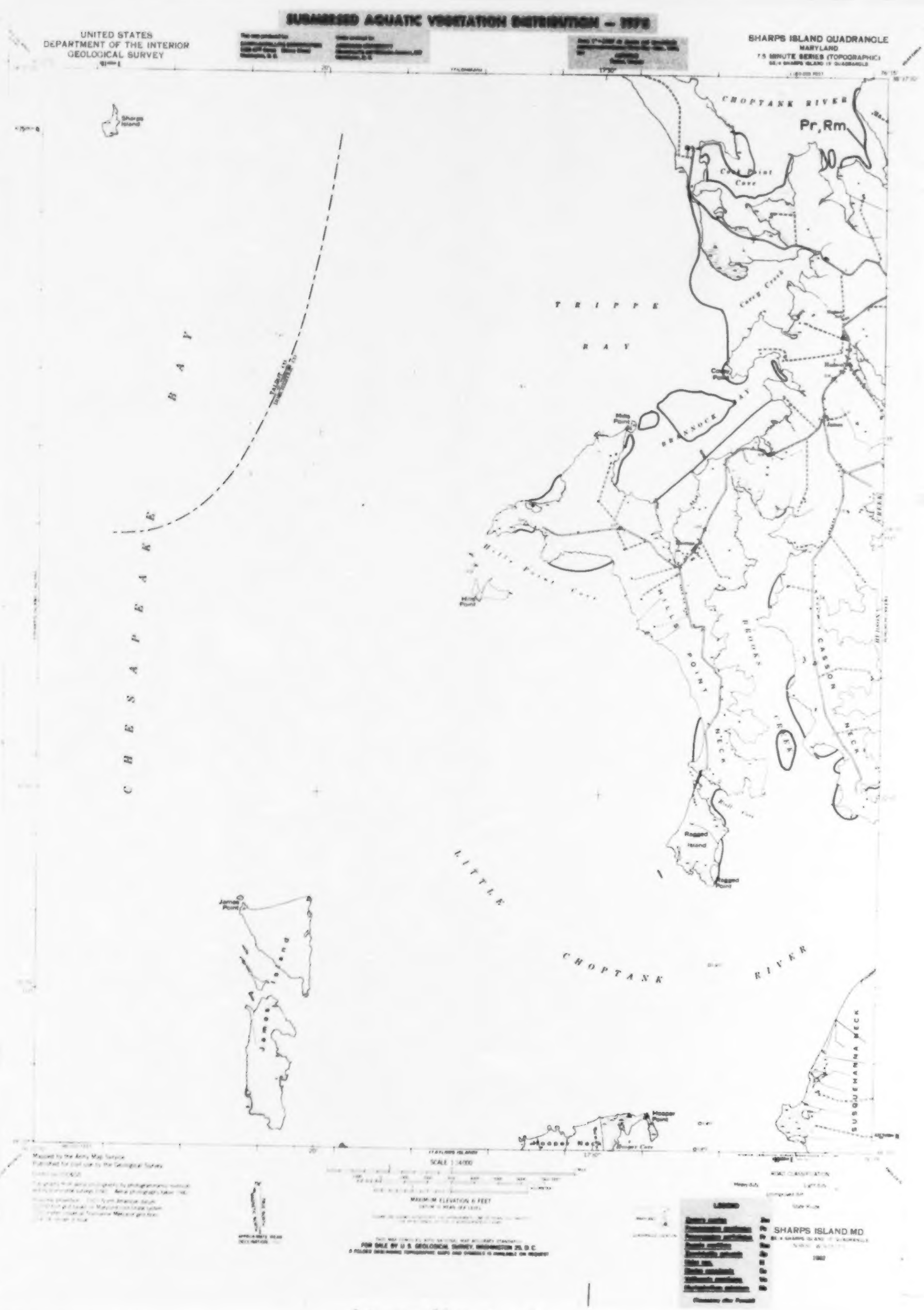
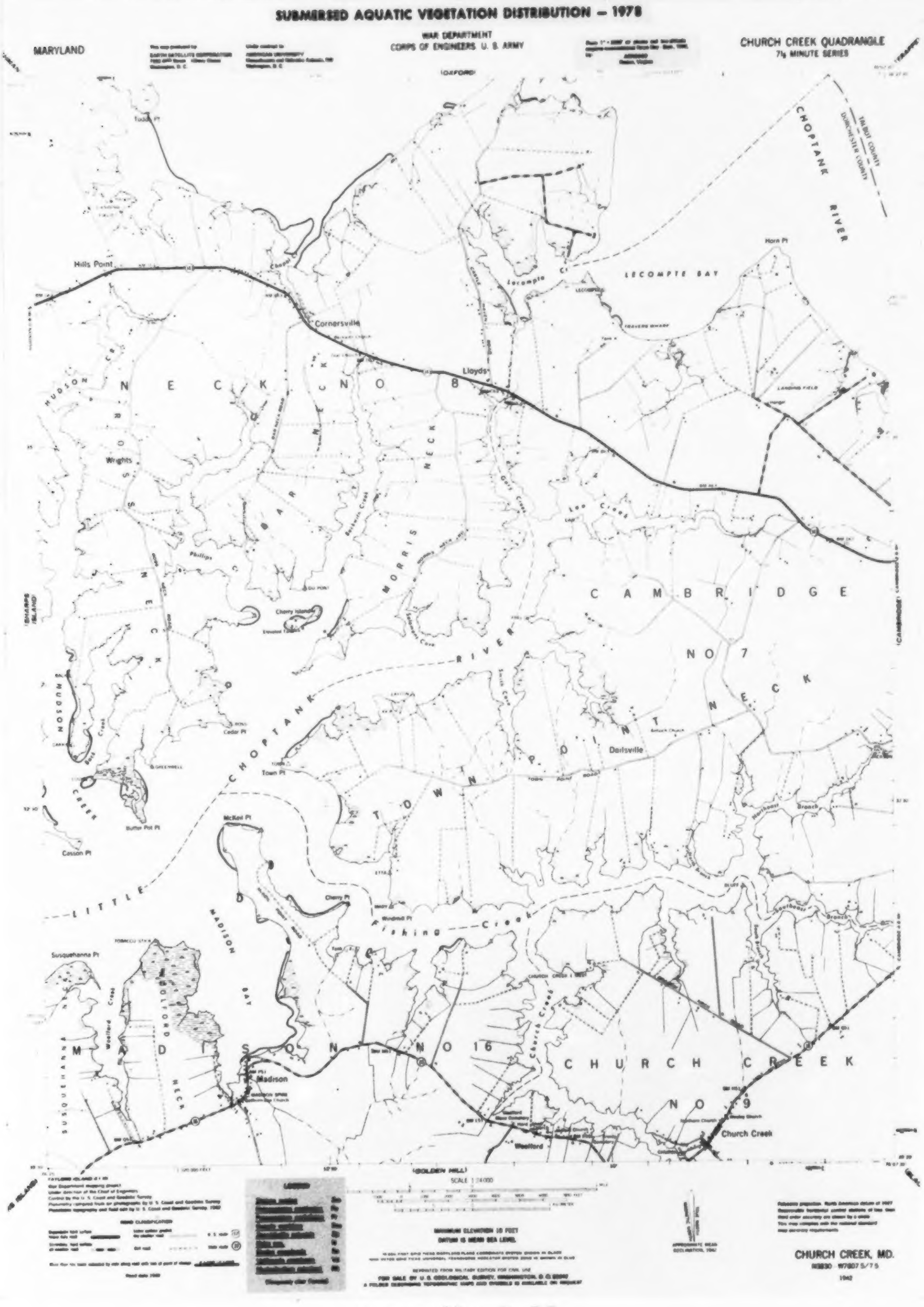
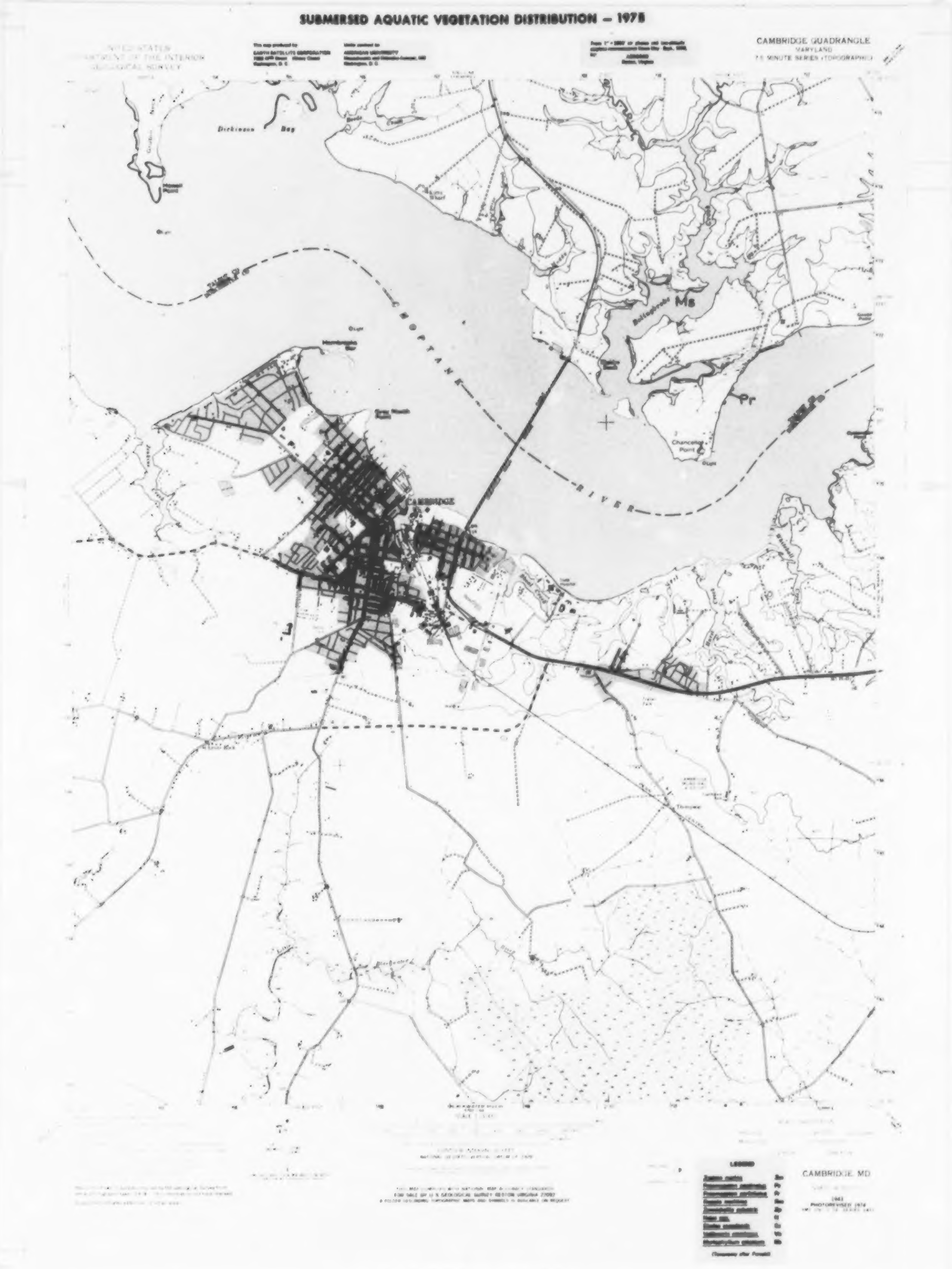
best available copy.

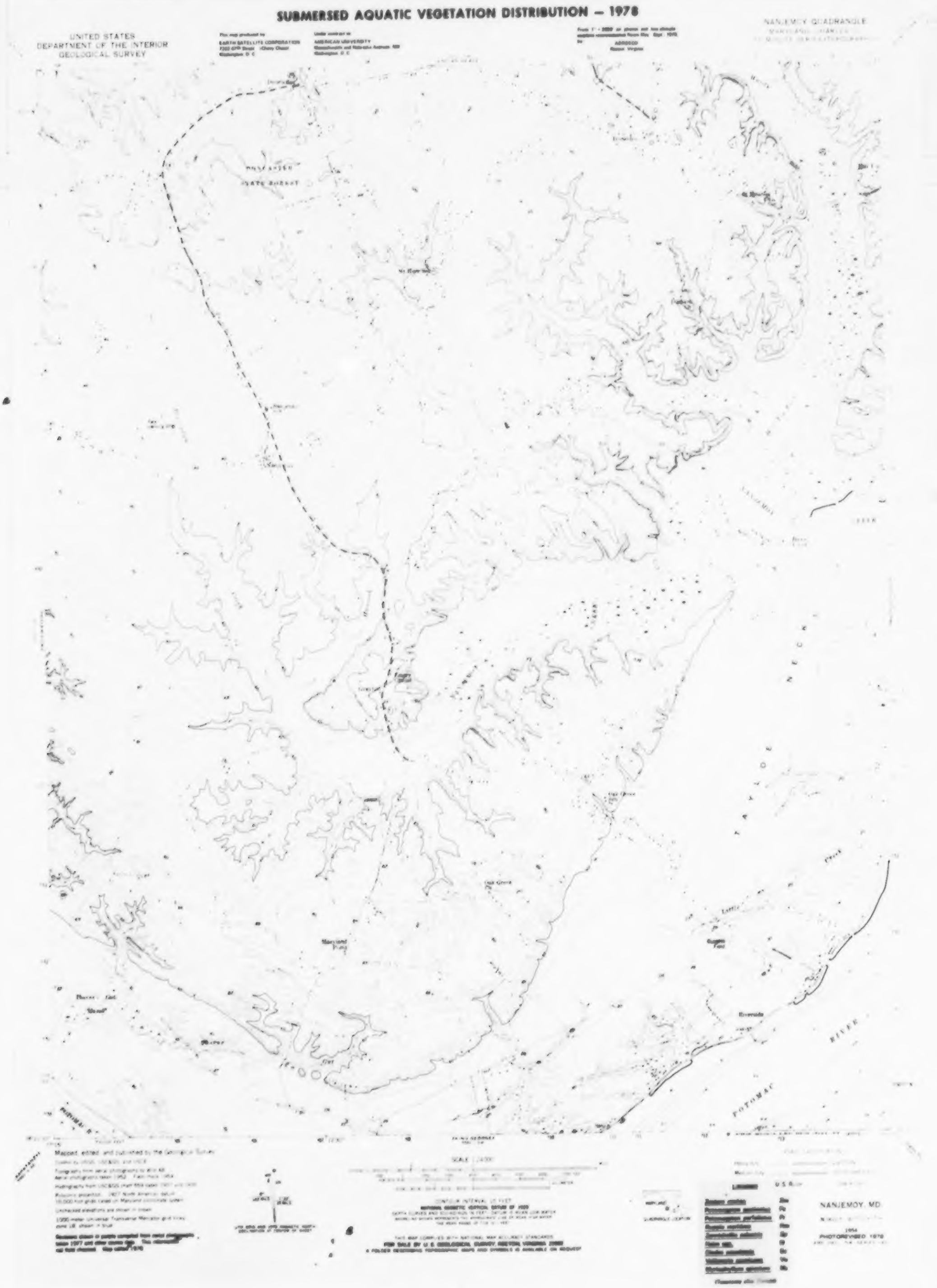

SUBMERSED AQUATIC VEGETATION DISTRIBUTION – 1978
UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
SHARPS ISLAND QUADRANGLE
MARYLAND
7.5 MINUTE SERIES (TOPOGRAPHIC)
Sharps Island
CHOPTANK RIVER
Pr,Rm
TRIPPE BAY
CHESAPEAKE BAY
LITTLE CHOPTANK RIVER
Ragged Island
Ragged Point
James Point
Hooper Point
Hooper Neck
SUSQUEHANNA NECK
SCALE 1:24000
ROAD CLASSIFICATION
LEGEND
SHARPS ISLAND MD
1942

Appendix G-34

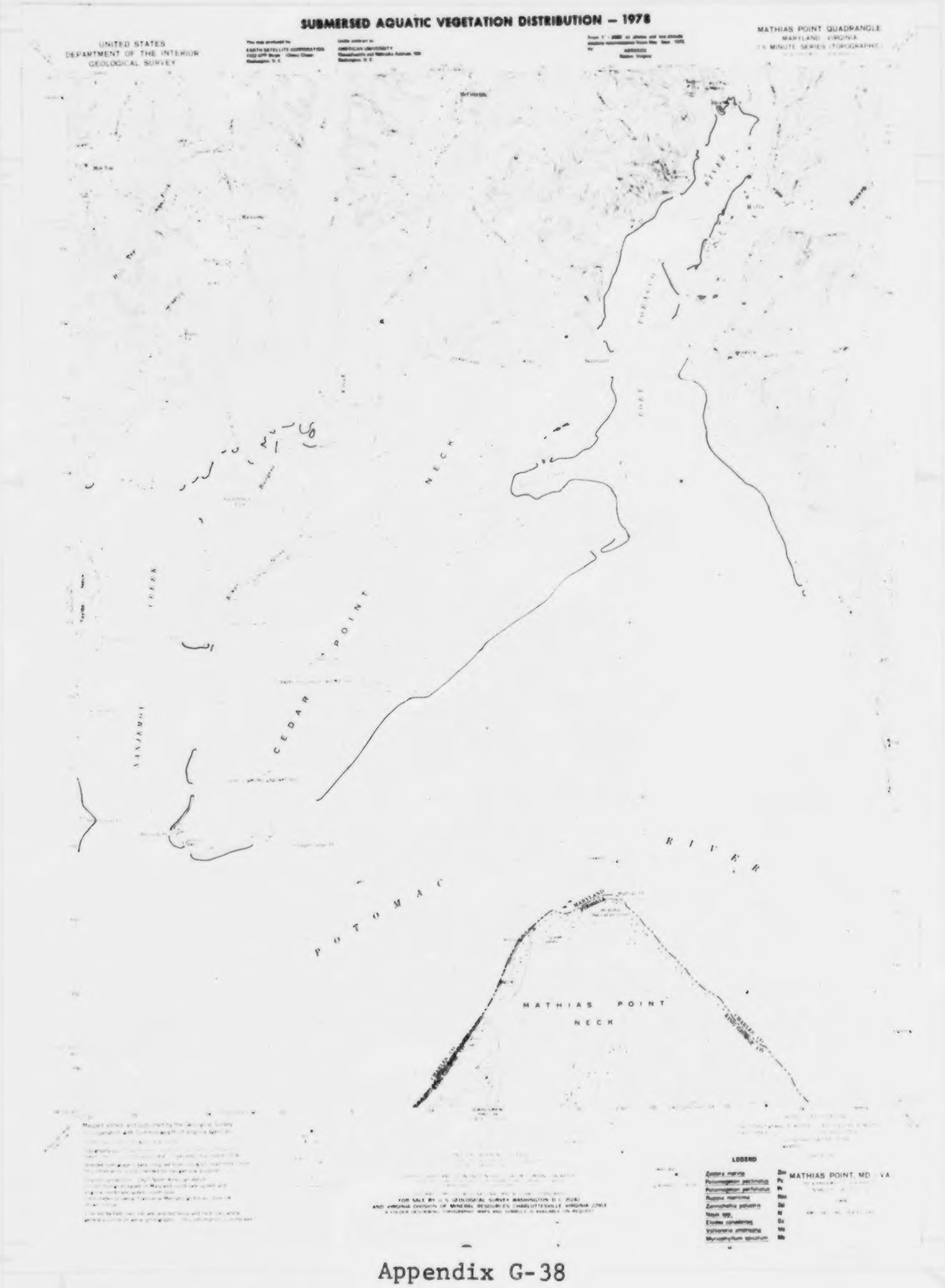

SUBMERSED AQUATIC VEGETATION DISTRIBUTION – 1978
MARYLAND
WAR DEPARTMENT
CORPS OF ENGINEERS U. S. ARMY
CHURCH CREEK QUADRANGLE
7½ MINUTE SERIES
OXFORD
CHOPTANK RIVER
TALBOT COUNTY
DORCHESTER COUNTY
LECOMPTE BAY
Horn Pt
Todds Pt
Hills Point
Cornersville
Lloyds
Wrights
HUDSON
NECK NO 8
BAR NECK
MORRIS NECK
CAMBRIDGE NO 7
NECK
TOWN POINT
Town Pt
Dorlsville
LITTLE CHOPTANK RIVER
McKeil Pt
Cherry Pt
Windmill Pt
Fishing Creek
MADISON BAY
Susquehanna Pt
MADISON NO 16
Madison
CHURCH CREEK NO 9
Church Creek
Woolford
Casson Pt
SHARPS ISLAND
GOLDEN HILL
SCALE 1:24000
CHURCH CREEK, MD.
1942

Appendix G-35


SUBMERSED AQUATIC VEGETATION DISTRIBUTION – 1978
UNITED STATES DEPARTMENT OF THE INTERIOR GEOLOGICAL SURVEY
CAMBRIDGE QUADRANGLE
MARYLAND
7.5 MINUTE SERIES (TOPOGRAPHIC)
Dickinson Bay
CHOPTANK
RIVER
CAMBRIDGE
Ms
Pr
Chancellor Point
LEGEND
CAMBRIDGE, MD
1942
PHOTOREVISED 1974

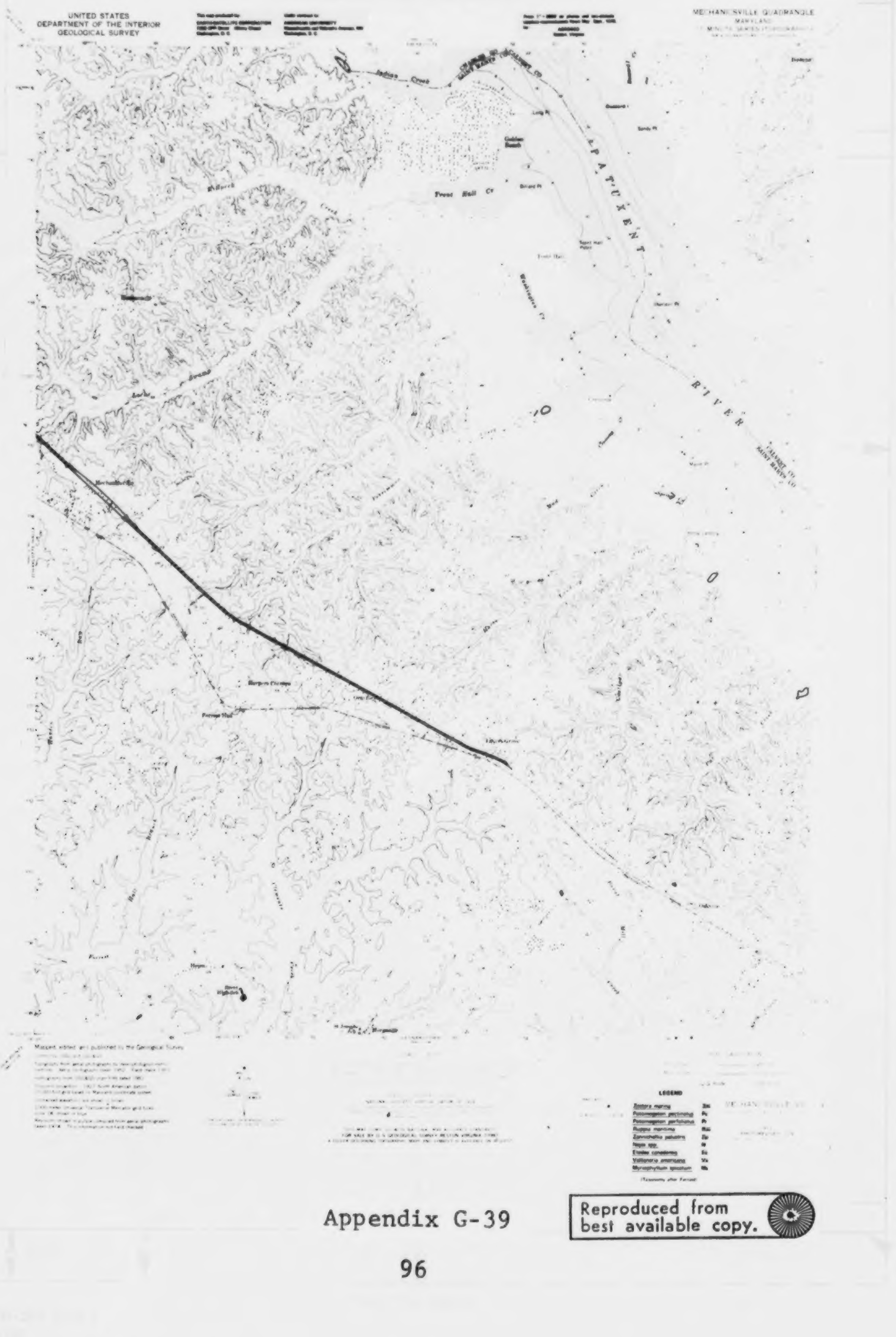

SUBMERSED AQUATIC VEGETATION DISTRIBUTION — 1978
UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
EARTH SATELLITE CORPORATION
AMERICAN UNIVERSITY
NANJEMOY QUADRANGLE
POTOMAC
RIVER
Mapped, edited, and published by the Geological Survey
SCALE 1:24000
CONTOUR INTERVAL 10 FEET
NANJEMOY, MD.
1956
PHOTOREVISED 1978

Appendix G-37


SUBMERSED AQUATIC VEGETATION DISTRIBUTION – 1978
UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
MATHIAS POINT QUADRANGLE
MARYLAND VIRGINIA
7.5 MINUTE SERIES (TOPOGRAPHIC)
CEDAR POINT
NECK
POTOMAC RIVER
MATHIAS POINT
NECK
MARYLAND
VIRGINIA
FOR SALE BY U.S. GEOLOGICAL SURVEY WASHINGTON D.C. 20242
AND VIRGINIA DIVISION OF MINERAL RESOURCES CHARLOTTESVILLE VIRGINIA 22903
LEGEND
Zostera marina Zm
Potamogeton pectinatus
Potamogeton perfoliatus
Ruppia maritima Rm
Zannichellia palustris Zp
Najas spp. N
Elodea canadensis Ec
Vallisneria americana Va
Myriophyllum spicatum Ms
MATHIAS POINT, MD – VA

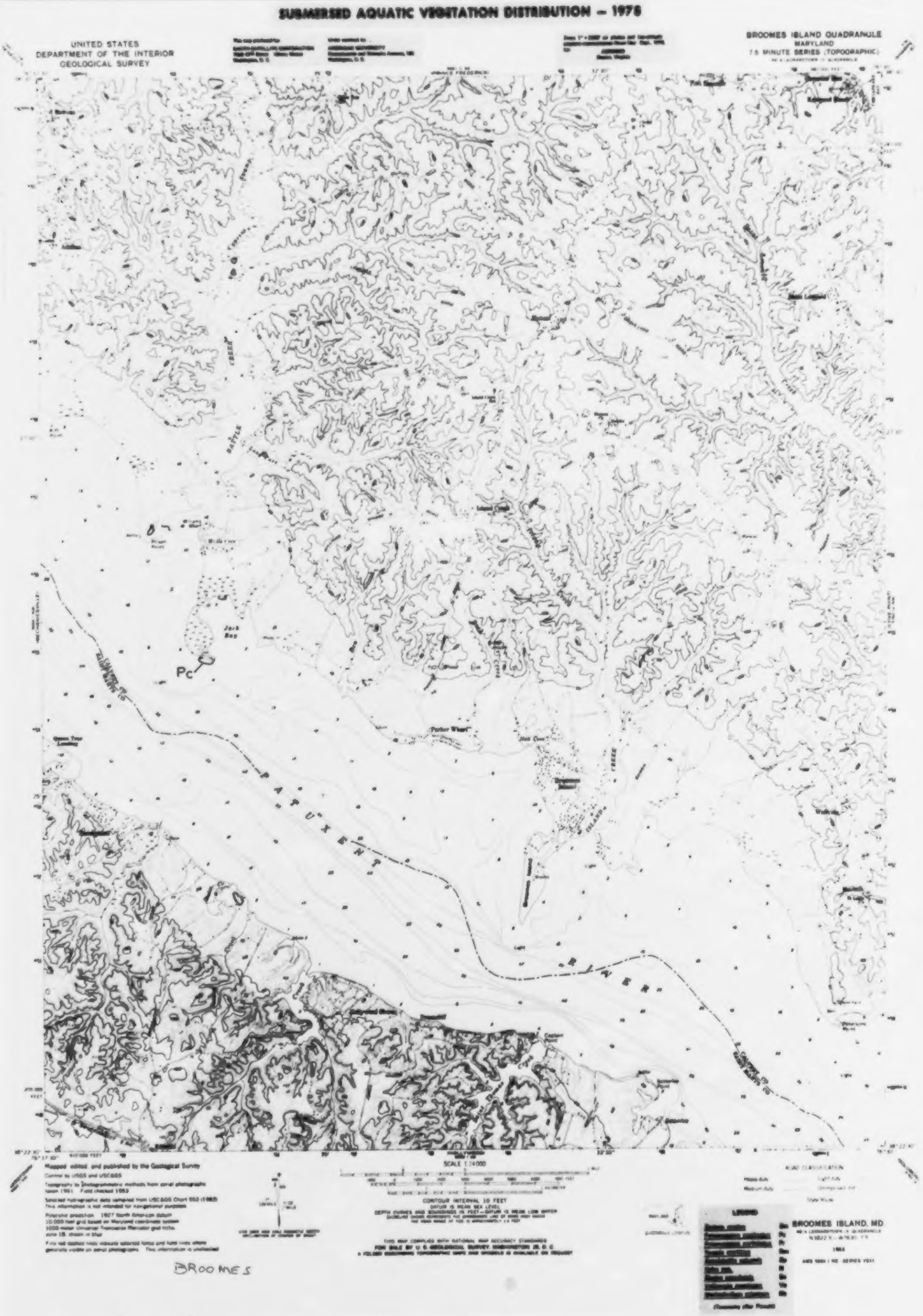
Appendix G-38

SUBMERSED AQUATIC VEGETATION DISTRIBUTION — 1978

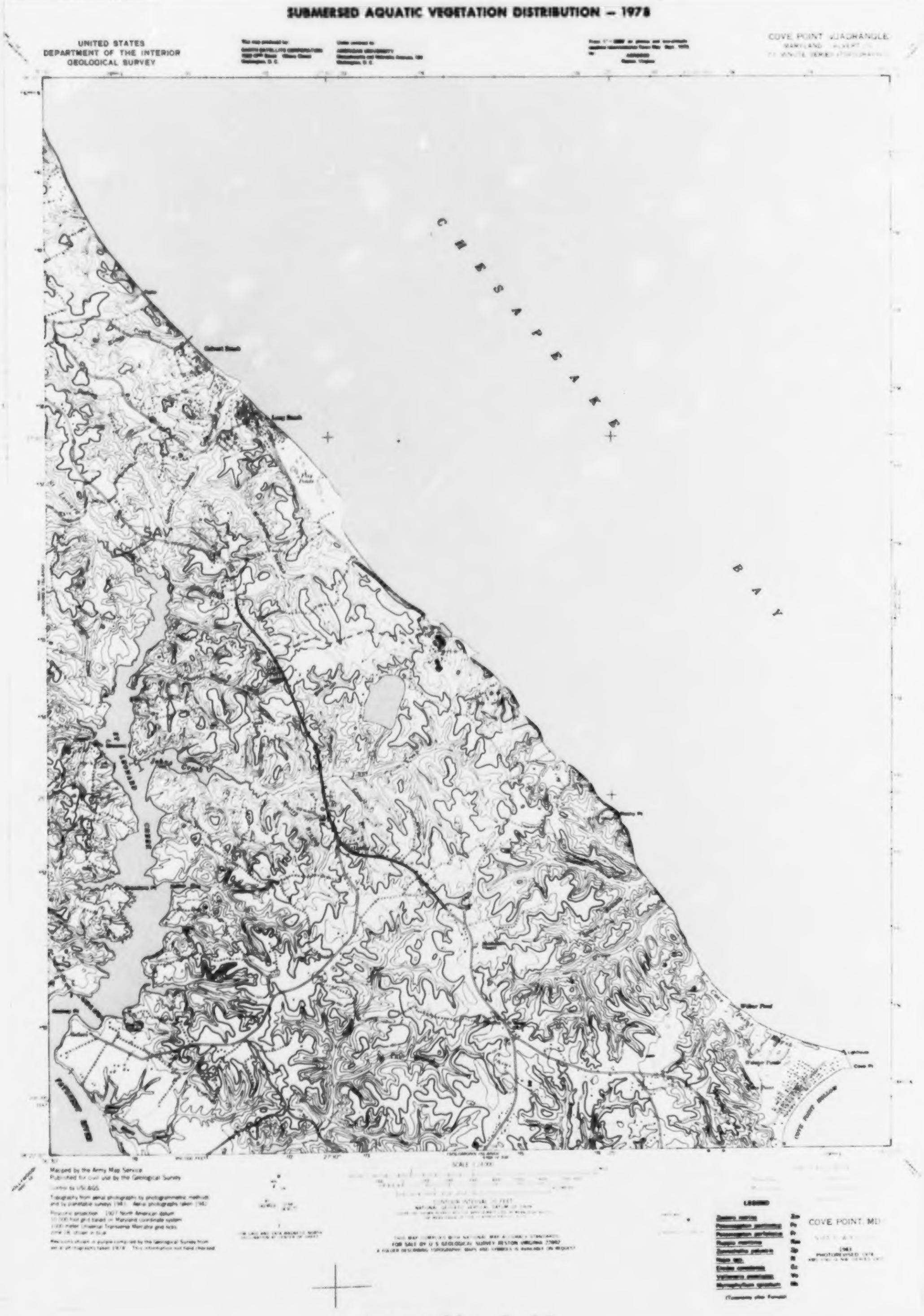


UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
MECHANICSVILLE QUADRANGLE
MARYLAND
7.5 MINUTE SERIES (TOPOGRAPHIC)
Indian Creek
CALVERT CO
ST. MARY'S CO
PATUXENT
RIVER
Trent Hall Cr
Mechanicsville
LEGEND
Zostera marina Zm
Potamogeton pectinatus Pp
Potamogeton perfoliatus Pr
Ruppia maritima Rm
Zannichellia palustris Zp
Najas spp. N
Elodea canadensis Ec
Vallisneria americana Va
Myriophyllum spicatum Ms
(Taxonomy after Fernald)

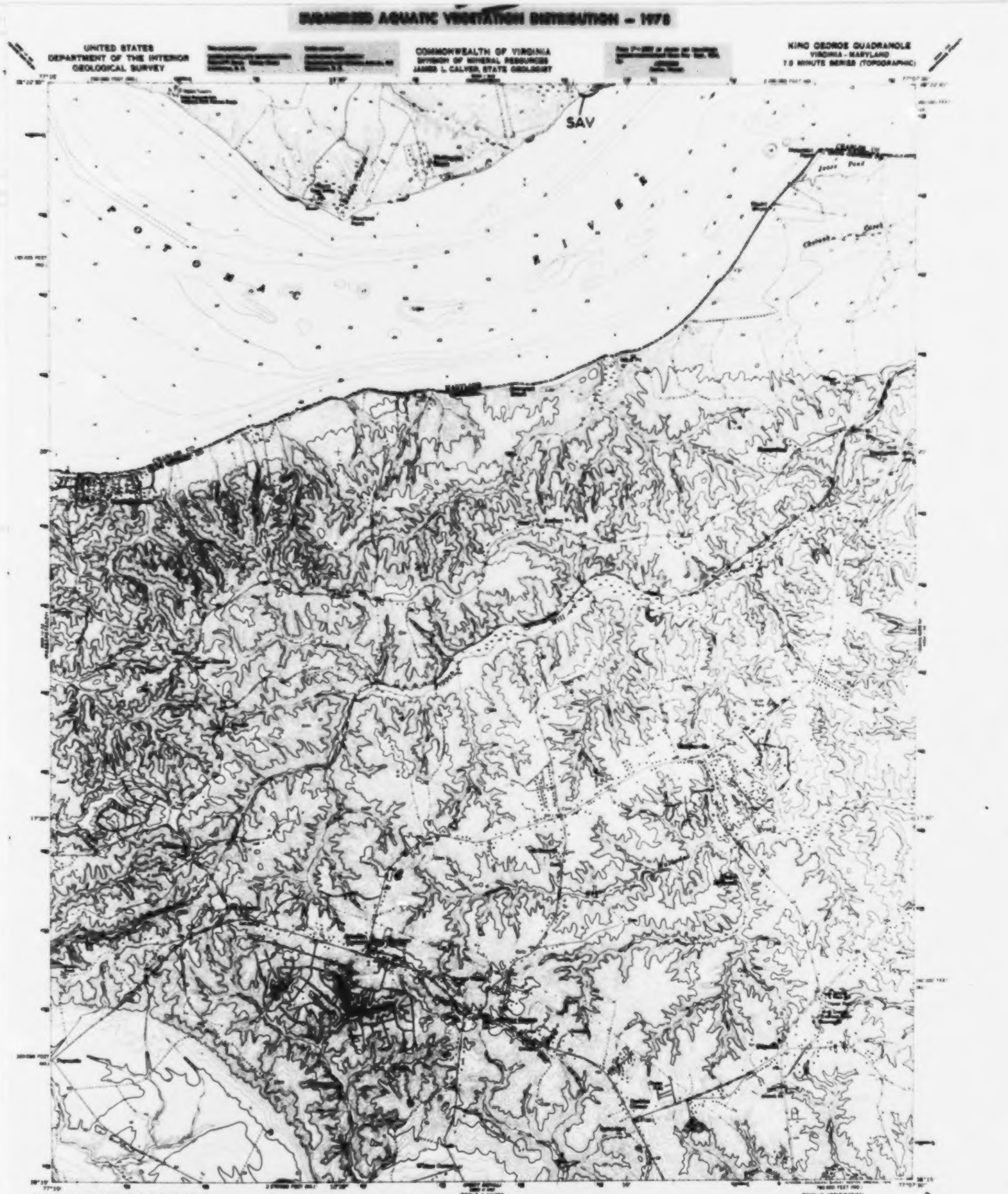
Reproduced from best available copy.


SUBMERSED AQUATIC VEGETATION DISTRIBUTION – 1978
UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
BROOMES ISLAND QUADRANGLE
MARYLAND
7.5 MINUTE SERIES (TOPOGRAPHIC)
Jack Bay
Pc
Parker Wharf
PATUXENT
RIVER
Mapped, edited, and published by the Geological Survey
SCALE 1:24000
CONTOUR INTERVAL 10 FEET
LEGEND
BROOMES ISLAND, MD.
BROOMES

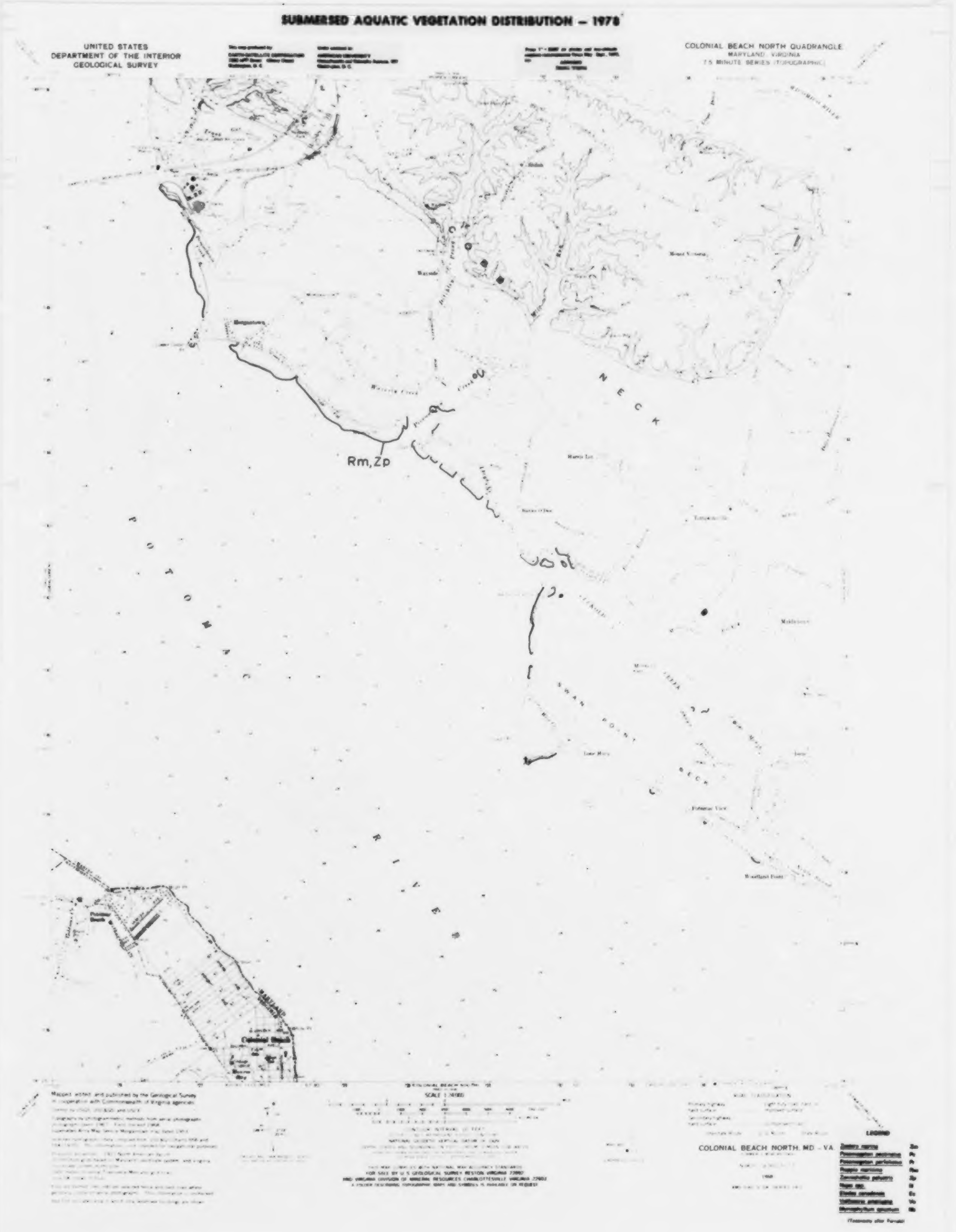
Appendix G-40


SUBMERSED AQUATIC VEGETATION DISTRIBUTION — 1978
UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
COVE POINT QUADRANGLE
CHESAPEAKE
BAY
LEGEND
COVE POINT, MD.

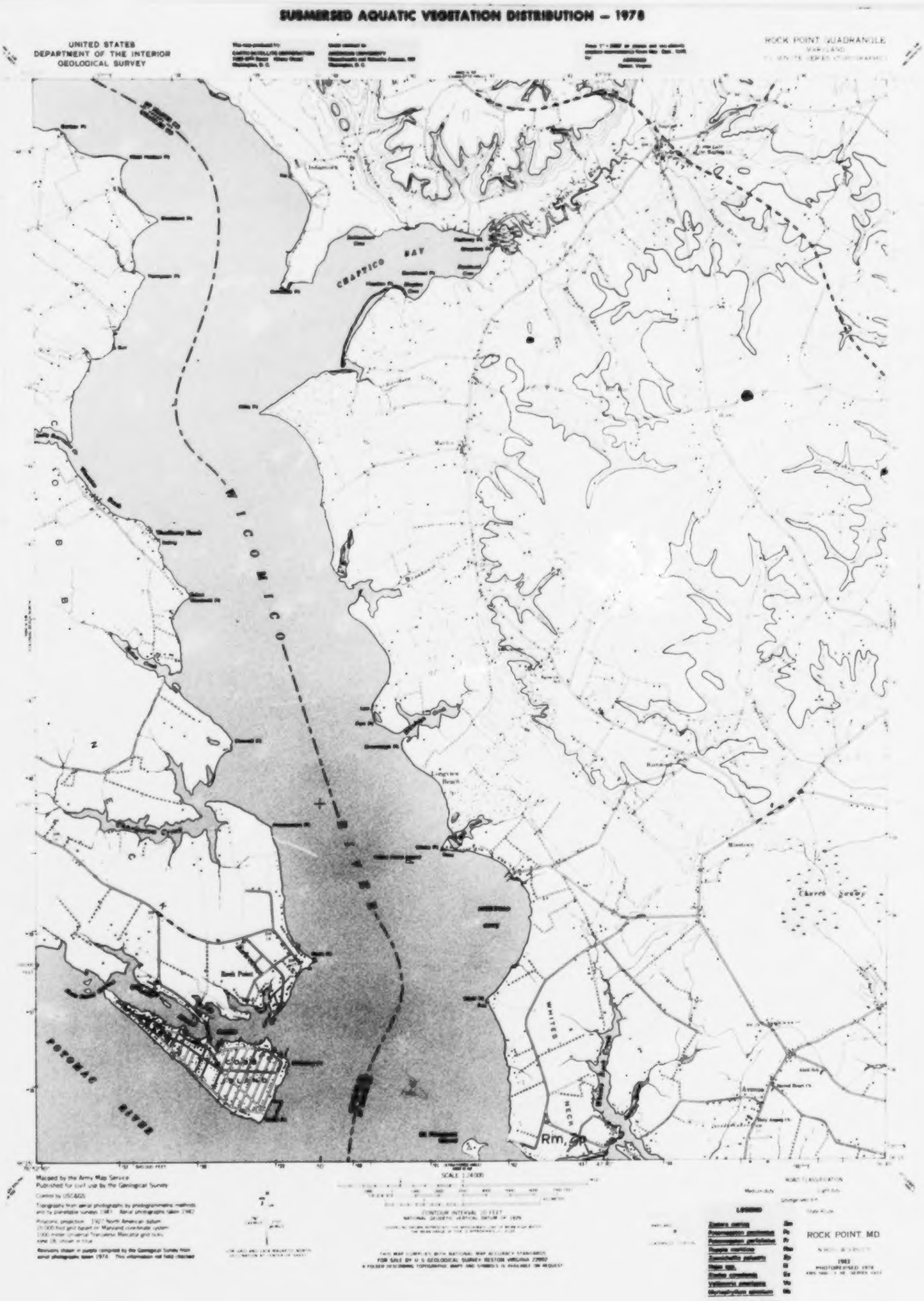
Appendix G-41


SUBMERGED AQUATIC VEGETATION DISTRIBUTION – 1978
UNITED STATES DEPARTMENT OF THE INTERIOR GEOLOGICAL SURVEY
COMMONWEALTH OF VIRGINIA DIVISION OF MINERAL RESOURCES JAMES L. CALVER, STATE GEOLOGIST
KING GEORGE QUADRANGLE VIRGINIA - MARYLAND 7.5 MINUTE SERIES (TOPOGRAPHIC)
SAV
SCALE 1:24000
CONTOUR INTERVAL 10 FEET
KING GEORGE, VA.–MD.

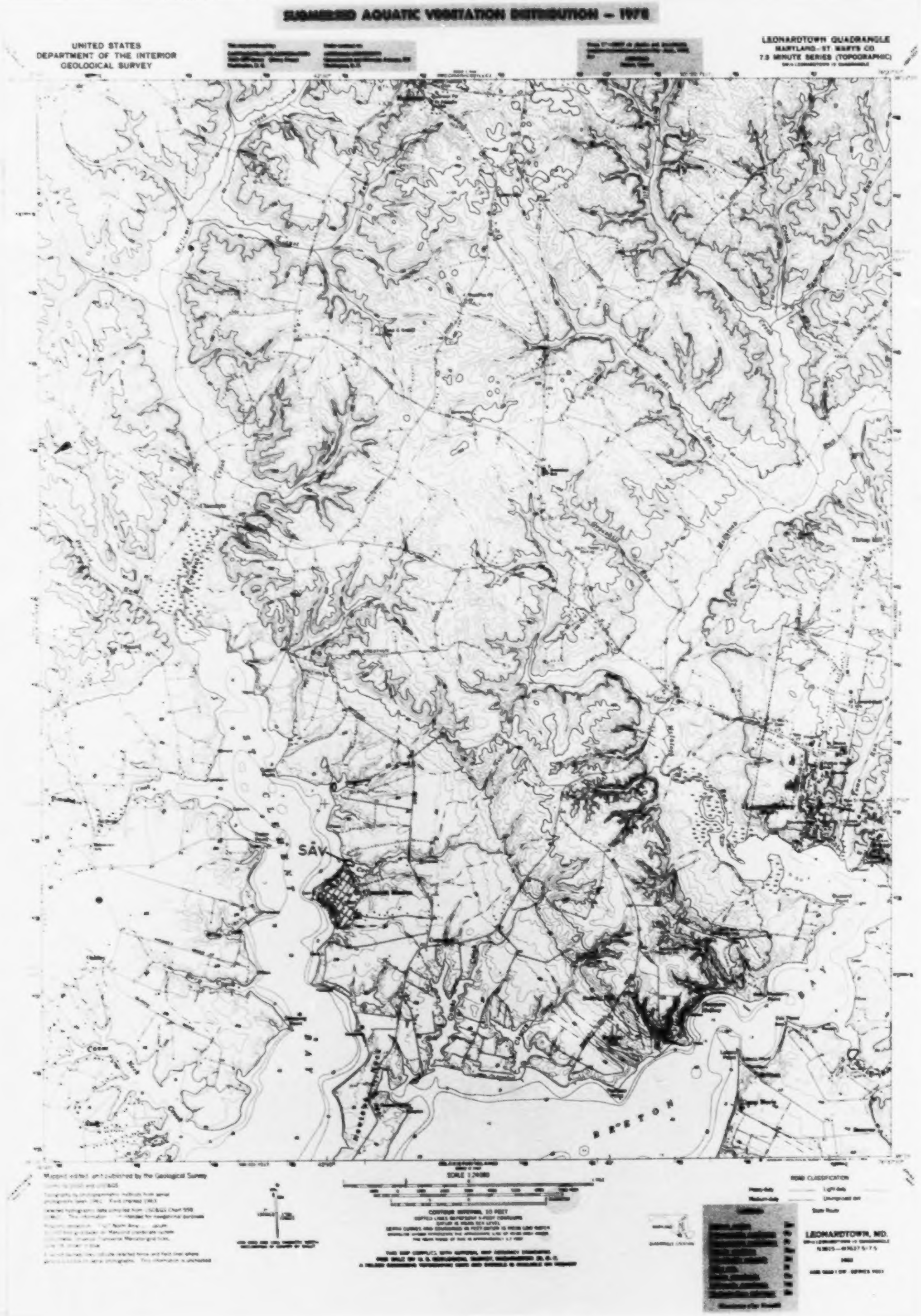
Appendix G-42


SUBMERSED AQUATIC VEGETATION DISTRIBUTION – 1978
UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
COLONIAL BEACH NORTH QUADRANGLE
MARYLAND VIRGINIA
7.5 MINUTE SERIES (TOPOGRAPHIC)
Rm,Zp
NECK
POTOMAC
RIVER
SWAN POINT NECK
Colonial Beach
SCALE 1:24000
COLONIAL BEACH NORTH, MD.-VA.
LEGEND
Zostera marina Zm
Potamogeton pectinatus Pc
Potamogeton perfoliatus Pp
Ruppia maritima Rm
Zannichellia palustris Zp
Najas sp. N
Elodea canadensis Ec
Vallisneria americana Va
Myriophyllum spicatum Ms
(Taxonomy after Fernald)

Appendix G-43


SUBMERSED AQUATIC VEGETATION DISTRIBUTION – 1978
UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
ROCK POINT QUADRANGLE
MARYLAND
CHAPTICO BAY
WICOMICO
RIVER
POTOMAC
RIVER
NECK
Rm, Zp
Church Swamp
LEGEND
ROCK POINT, MD.

Appendix G-44


SUBMERSED AQUATIC VEGETATION DISTRIBUTION – 1978
UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
LEONARDTOWN QUADRANGLE
MARYLAND–ST. MARYS CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)
SAV
LEONARDTOWN, MD.

Appendix G-45

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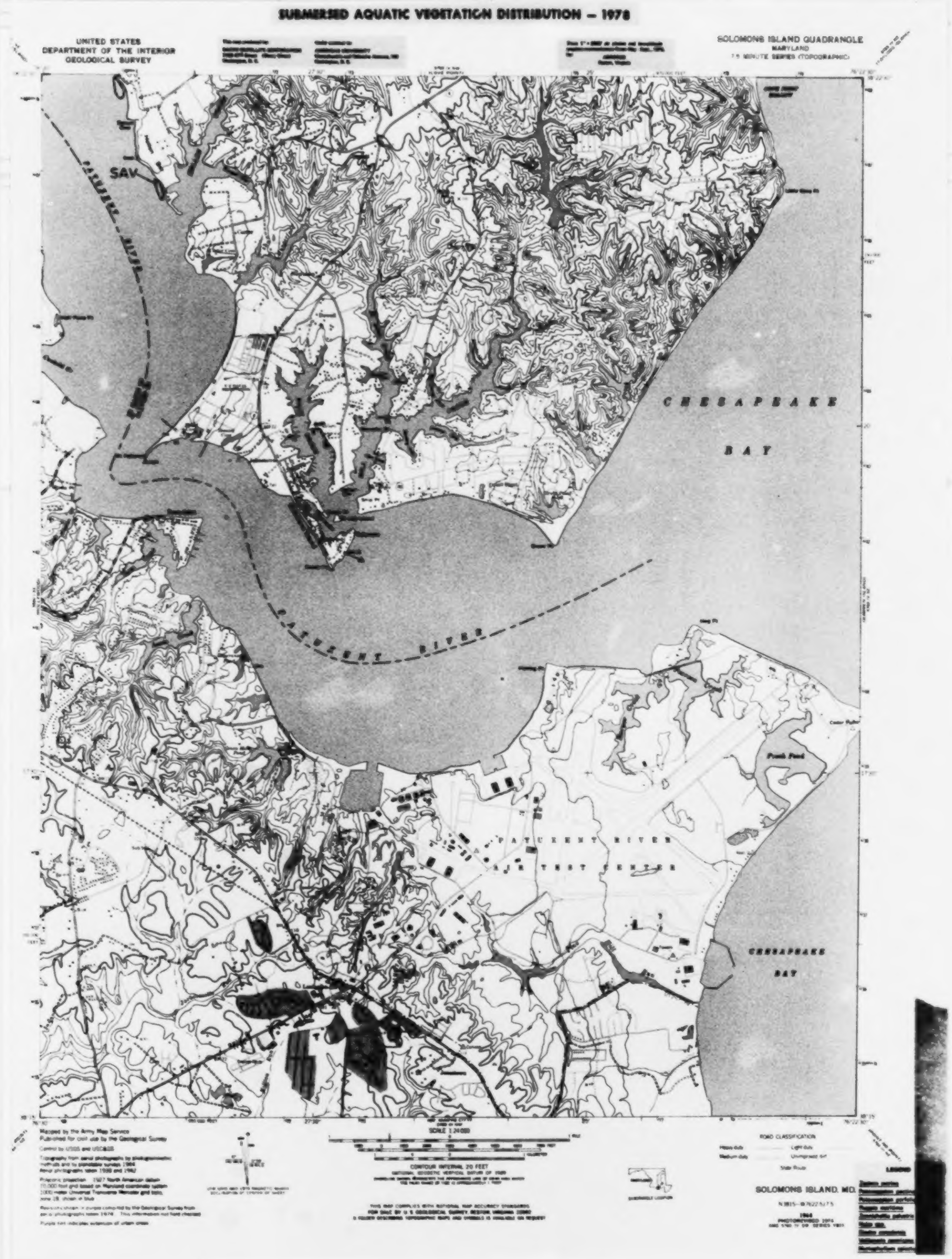
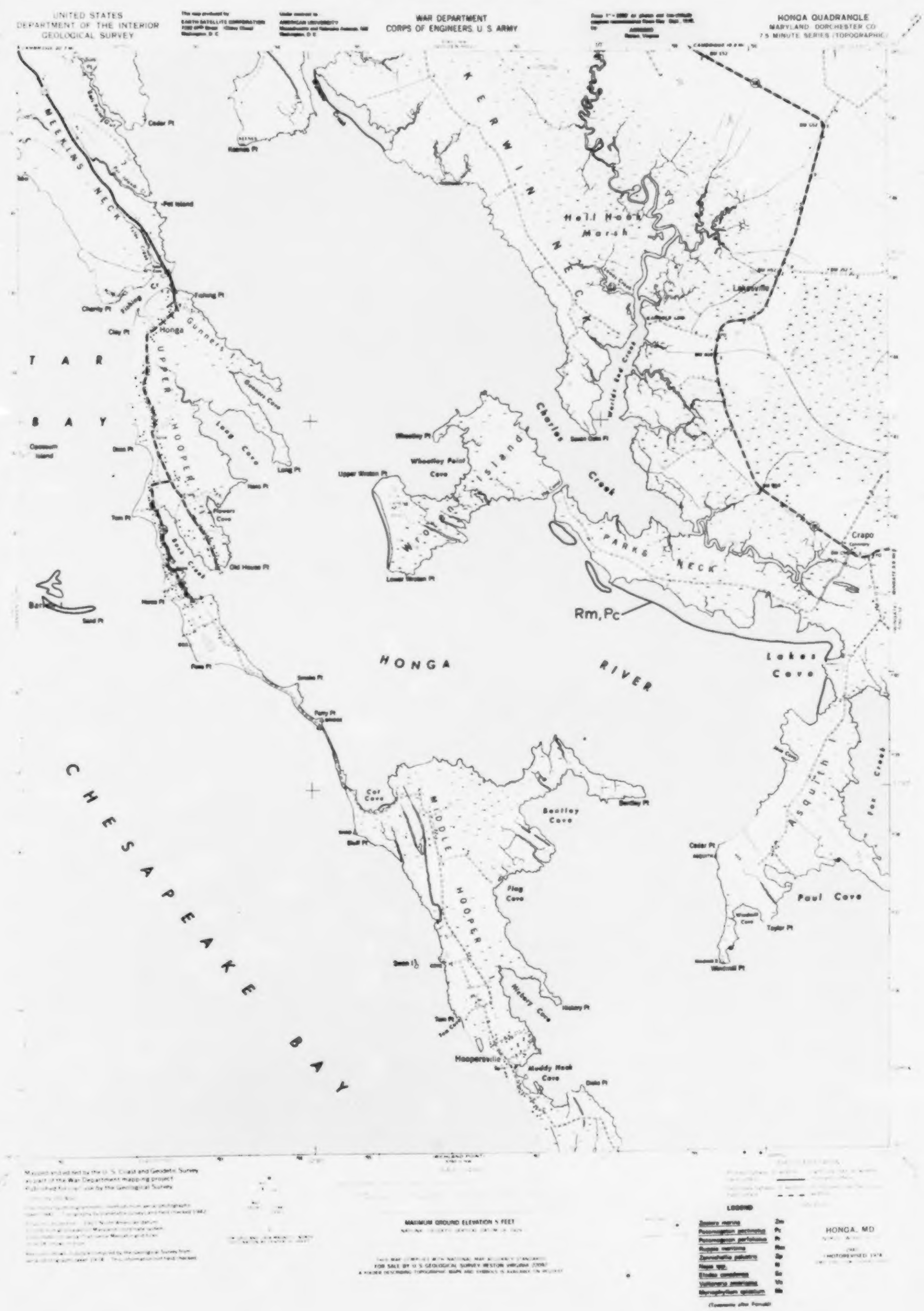
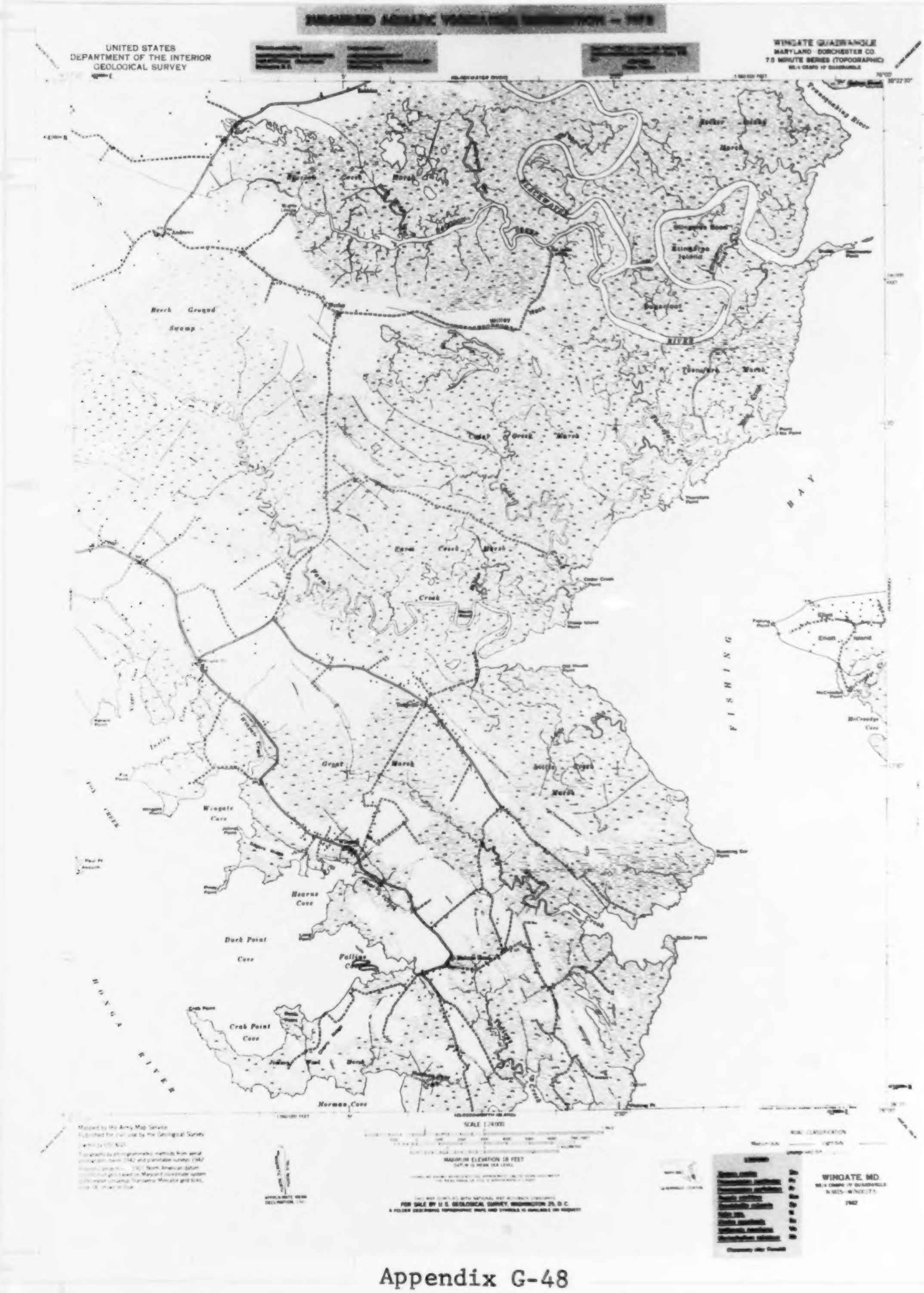

SUBMERSED AQUATIC VEGETATION DISTRIBUTION – 1978
UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
SOLOMONS ISLAND QUADRANGLE
MARYLAND
7.5 MINUTE SERIES (TOPOGRAPHIC)
SAV
PATUXENT RIVER
CHESAPEAKE
BAY
PATUXENT RIVER
NAVAL AIR TEST CENTER
CHESAPEAKE
BAY
SCALE 1:24 000
CONTOUR INTERVAL 20 FEET
SOLOMONS ISLAND, MD.
LEGEND

Appendix G-46

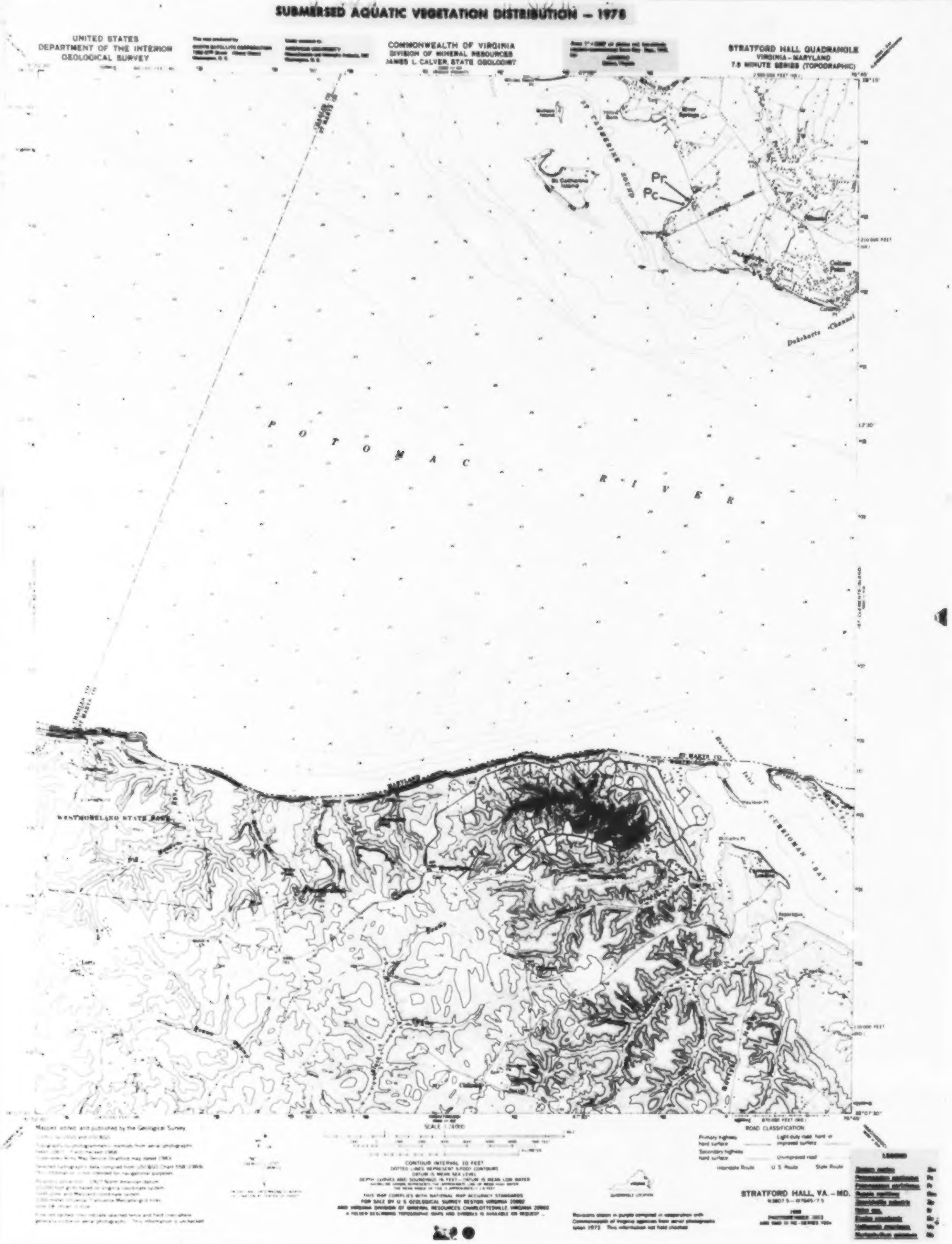
SUBMERSED AQUATIC VEGETATION DISTRIBUTION – 1978


UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
WAR DEPARTMENT
CORPS OF ENGINEERS, U.S. ARMY
HONGA QUADRANGLE
MARYLAND DORCHESTER CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)
MEEKINS NECK
KERWIN NECK
Hell Hook Marsh
Lakesville
TAR BAY
UPPER HOOPER
Honga
Wheatley Pt
Upper Wroten Pt
Lower Wroten Pt
Charles Creek
PARKS NECK
Crapo
Rm, Pc
HONGA RIVER
Lakes Cove
CHESAPEAKE BAY
Cat Cove
MIDDLE HOOPER
Bentley Cove
Flag Cove
Hickory Cove
Hoopersville
Muddy Hook Cove
Paul Cove
Taylor Pt
Windmill Pt
Cedar Pt
MAXIMUM GROUND ELEVATION 5 FEET
LEGEND
Zostera marina Zm
Potamogeton pectinatus Pc
Potamogeton perfoliatus Pp
Ruppia maritima Rm
Zannichellia palustris Zp
Najas spp.
Elodea canadensis
Vallisneria americana
Myriophyllum spicatum
HONGA, MD

Appendix G-47


SUBMERGED AQUATIC VEGETATION DISTRIBUTION
UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
WINGATE QUADRANGLE
MARYLAND - DORCHESTER CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)
Transquaking River
BAY
FISHING
HONGA
RIVER
Beech Ground Swamp
Great Marsh
Wingate Cove
Hearns Cove
Duck Point Cove
Crab Point Cove
Norman Cove
SCALE 1:24000
WINGATE, MD.
1942

Appendix G-48


SUBMERSED AQUATIC VEGETATION DISTRIBUTION – 1978
UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
COMMONWEALTH OF VIRGINIA
DIVISION OF MINERAL RESOURCES
JAMES L. CALVER, STATE GEOLOGIST
STRATFORD HALL QUADRANGLE
VIRGINIA–MARYLAND
7.5 MINUTE SERIES (TOPOGRAPHIC)
Pr
Pc
Dukeharts Channel
P O T O M A C
R I V E R
WESTMORELAND STATE PARK
CURRIOMAN BAY
CONTOUR INTERVAL 10 FEET
ROAD CLASSIFICATION
Primary highway, hard surface
Light-duty road, hard or improved surface
Secondary highway, hard surface
Unimproved road
Interstate Route
U. S. Route
State Route
QUADRANGLE LOCATION
STRATFORD HALL, VA. – MD.
LEGEND

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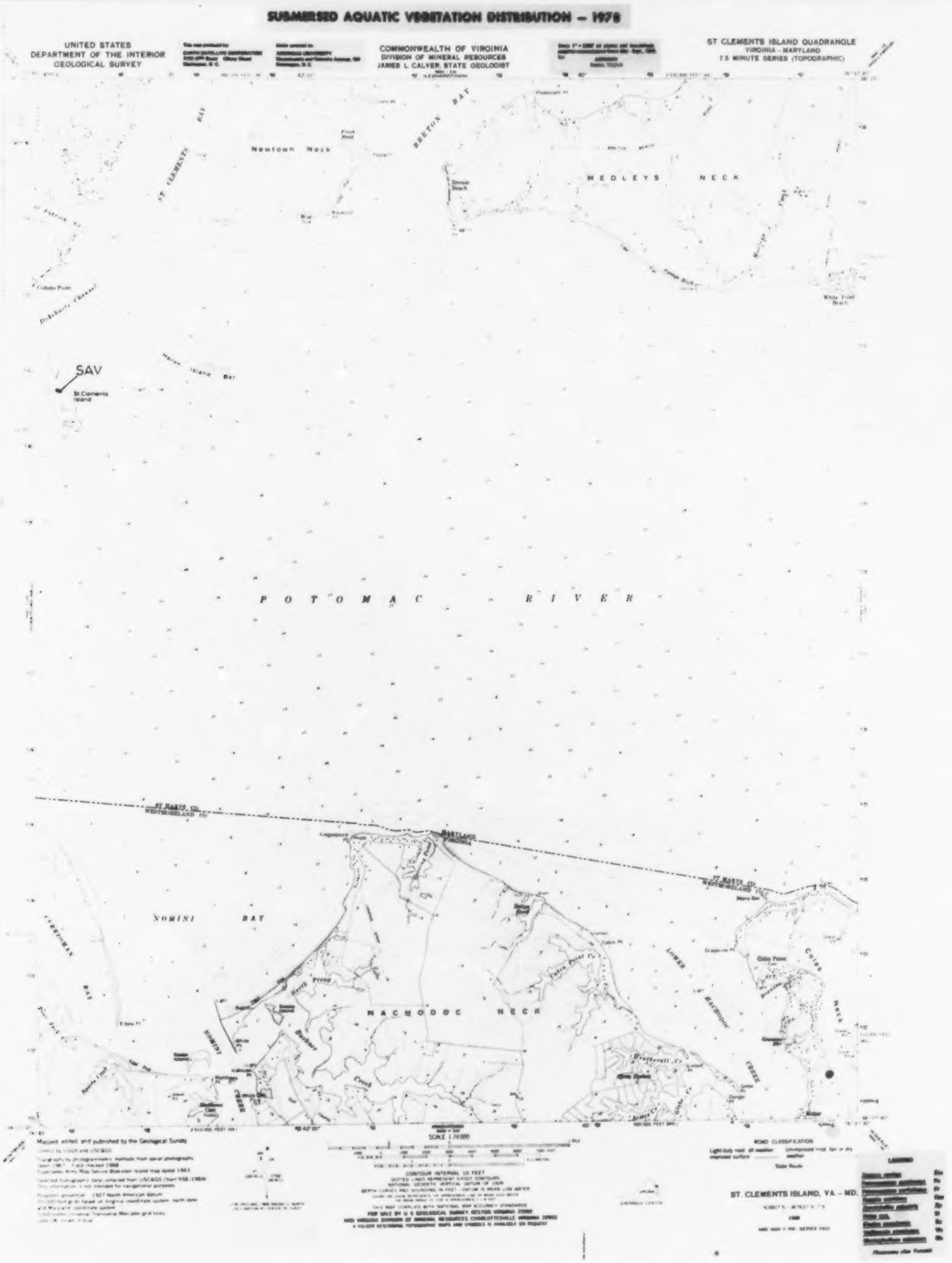
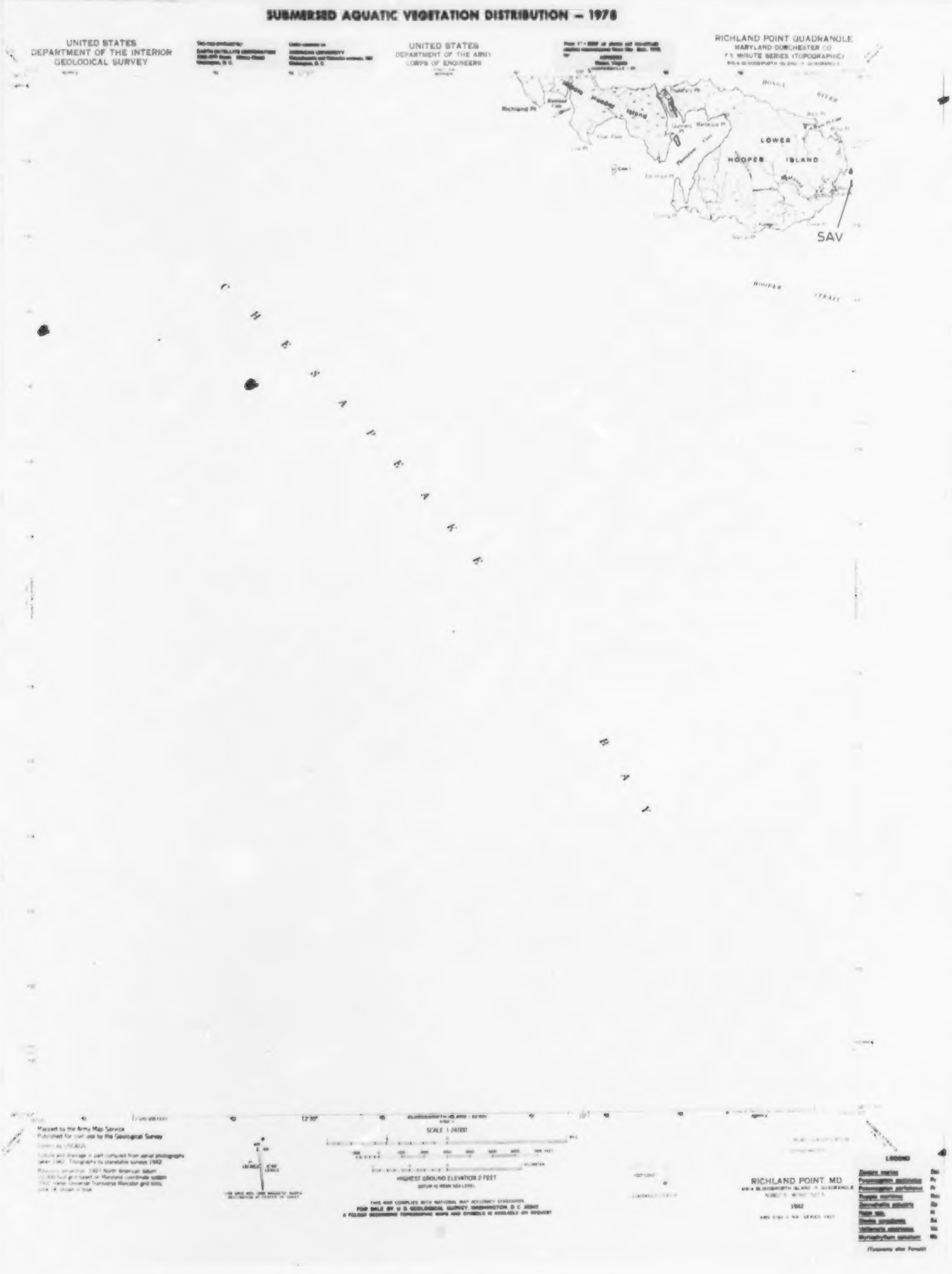
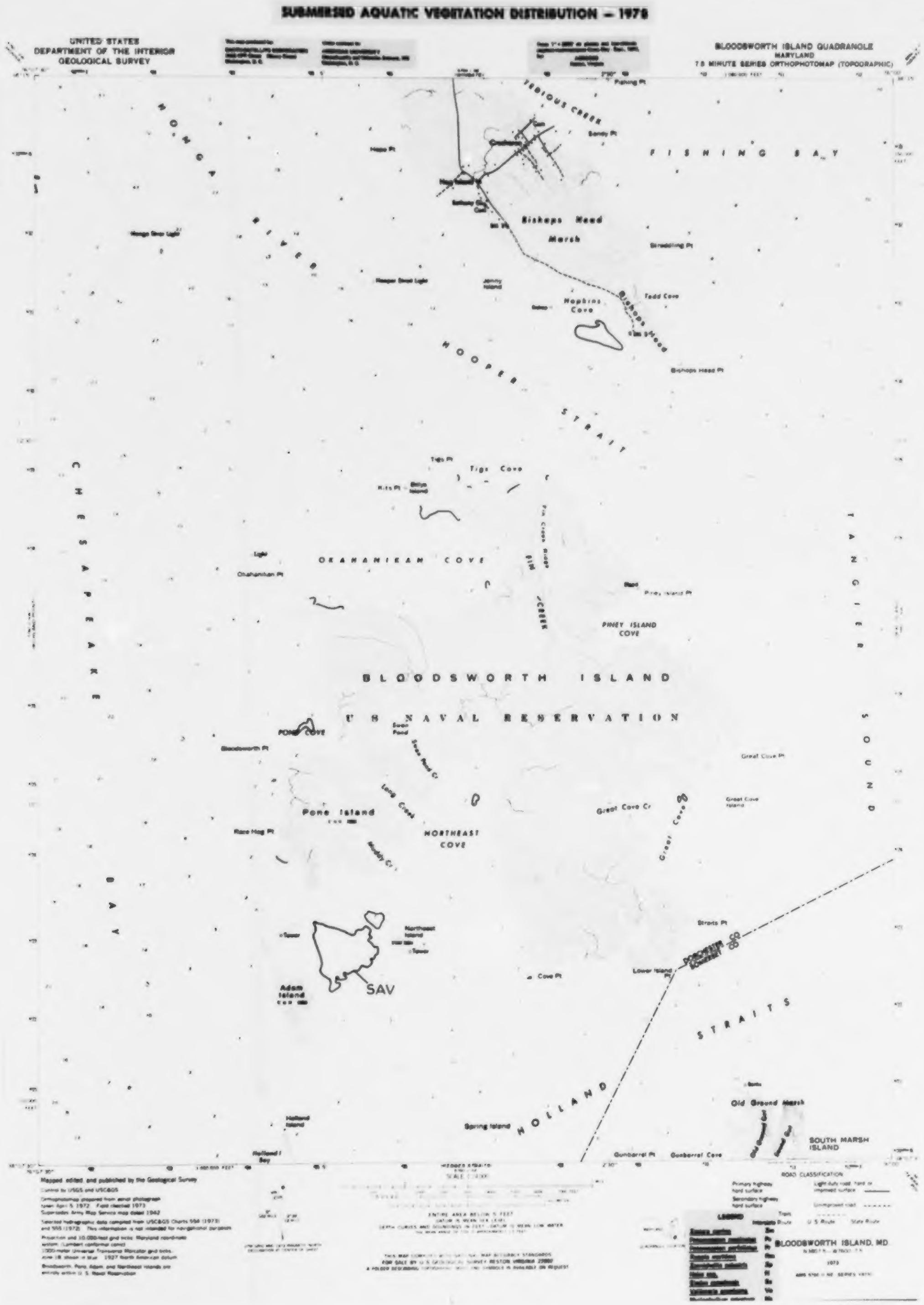
Appendix G-49


SUBMERSED AQUATIC VEGETATION DISTRIBUTION – 1978
UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
COMMONWEALTH OF VIRGINIA
DIVISION OF MINERAL RESOURCES
JAMES L. CALVER, STATE GEOLOGIST
ST CLEMENTS ISLAND QUADRANGLE
VIRGINIA - MARYLAND
7.5 MINUTE SERIES (TOPOGRAPHIC)
Newtown Neck
ST CLEMENTS BAY
BRETON BAY
MEDLEYS NECK
SAV
St Clements Island
POTOMAC RIVER
ST MARYS CO
WESTMORELAND CO
MARYLAND
VIRGINIA
NOMINI BAY
MACHODOC NECK
LOWER MACHODOC CREEK
NOMINI CREEK
CURRIOMAN BAY
SCALE 1:24 000
CONTOUR INTERVAL 10 FEET
ROAD CLASSIFICATION
LEGEND
ST. CLEMENTS ISLAND, VA.–MD.

Appendix G-50


SUBMERSED AQUATIC VEGETATION DISTRIBUTION — 1978
UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
UNITED STATES
DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
RICHLAND POINT QUADRANGLE
MARYLAND-DORCHESTER CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)
Richland Pt
LOWER
HOOPER ISLAND
SAV
HOOPER
STRAIT
CHESAPEAKE
BAY
SCALE 1:24000
HIGHEST GROUND ELEVATION 2 FEET
RICHLAND POINT, MD
1942
LEGEND

Appendix G-51


SUBMERSED AQUATIC VEGETATION DISTRIBUTION – 1979

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
BLOODSWORTH ISLAND QUADRANGLE
MARYLAND
7.5 MINUTE SERIES ORTHOPHOTOMAP (TOPOGRAPHIC)
Fishing Pt
TEDIOUS CREEK
Sandy Pt
FISHING BAY
Hoop Pt
HONGA RIVER
Bishops Head
Marsh
Straddling Pt
Hooper Strait Light
Jenny Island
Hopkins Cove
Todd Cove
Bishops Head Pt
HOOPER STRAIT
Tigs Pt
Tigs Cove
Kits Pt
CHESAPEAKE BAY
Light
Okahanikan Pt
OKAHANIKAN COVE
Fin Creek
Piney Island Pt
PINEY ISLAND COVE
TANGIER SOUND
BLOODSWORTH ISLAND
U S NAVAL RESERVATION
POND COVE
Bloodsworth Pt
Swan Pond
Long Cove
Pone Island
Northeast Cove
Great Cove Pt
Great Cove Island
Great Cove Cr
Northeast Island
Tower
Adam Island
SAV
Cove Pt
Lower Island Pt
Straits Pt
DORCHESTER CO
SOMERSET CO
HOLLAND STRAITS
Old Ground Marsh
Spring Island
Holland Island
Holland I Bay
Gunbarrel Pt
Gunbarrel Cove
SOUTH MARSH ISLAND
Mapped, edited, and published by the Geological Survey
ROAD CLASSIFICATION
LEGEND
BLOODSWORTH ISLAND, MD.
1973

Appendix G-52

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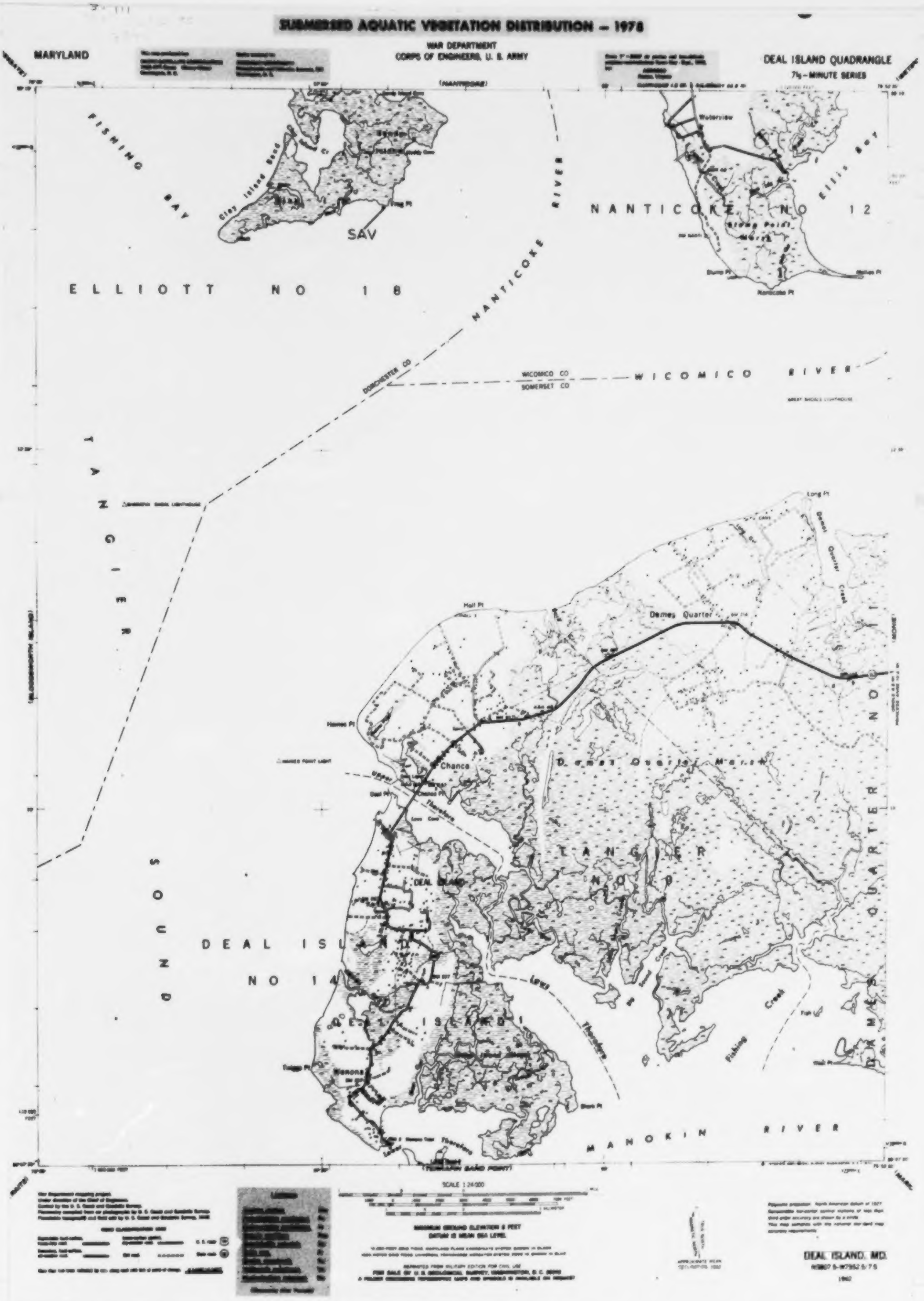
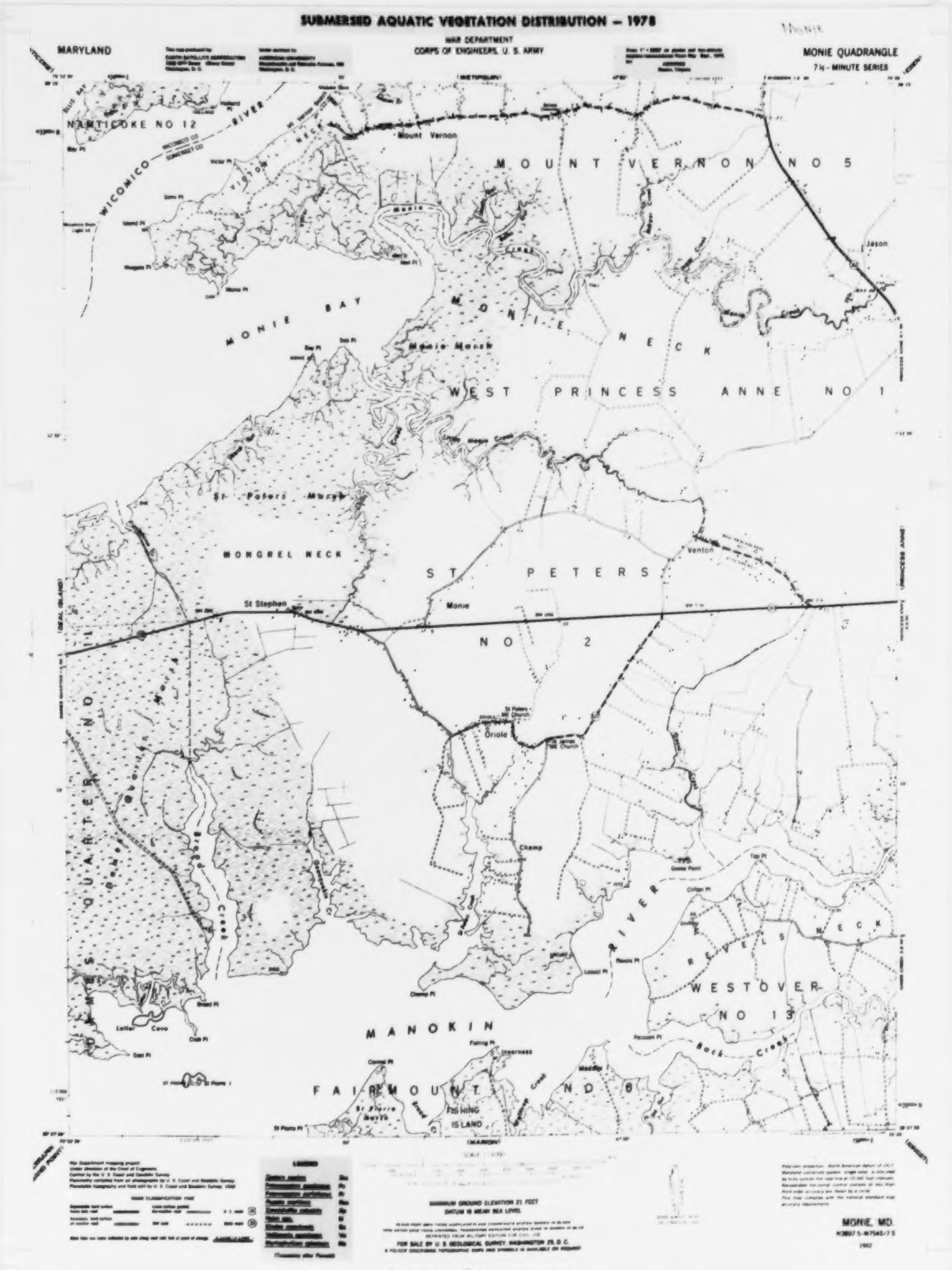
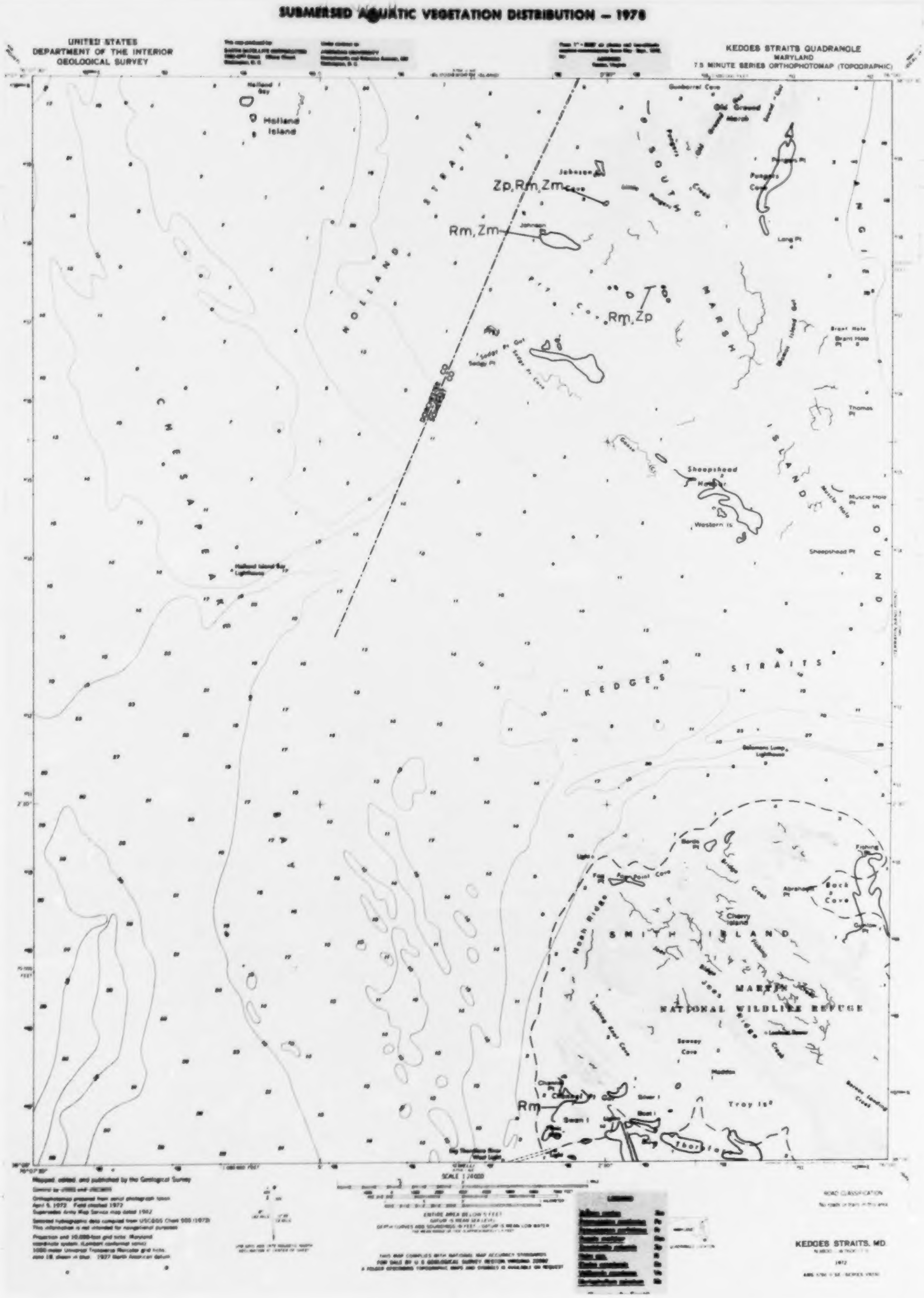

SUBMERSED AQUATIC VEGETATION DISTRIBUTION – 1978
MARYLAND
WAR DEPARTMENT
CORPS OF ENGINEERS, U. S. ARMY
DEAL ISLAND QUADRANGLE
7½-MINUTE SERIES
FISHING BAY
SAV
NANTICOKE RIVER
NANTICOKE NO 12
Ellis Bay
Waterview
ELLIOTT NO 18
DORCHESTER CO
WICOMICO CO
SOMERSET CO
WICOMICO RIVER
TANGIER
SOUND
Dames Quarter
Dames Quarter Marsh
Chance
DEAL ISLAND
DEAL ISLAND NO 14
TANGIER NO 9
DAMES QUARTER NO
MANOKIN RIVER
Wenona
SCALE 1:24 000
DEAL ISLAND, MD.
1942

Appendix G-53


SUBMERSED AQUATIC VEGETATION DISTRIBUTION – 1978
WAR DEPARTMENT
CORPS OF ENGINEERS, U. S. ARMY
MARYLAND
MONIE QUADRANGLE
7½-MINUTE SERIES
Monie
NANTICOKE NO 12
WICOMICO RIVER
MOUNT VERNON NO 5
Mount Vernon
Jason
MONIE BAY
Monie Marsh
MONIE NECK
WEST PRINCESS ANNE NO 1
St Peters Marsh
MONGREL NECK
ST PETERS NO 2
Venton
St Stephen
Monie
Oriole
Champ
QUANTICO NO
RIVER
REVELS NECK
WESTOVER NO 13
MANOKIN
FAIRMOUNT NO 8
FISHING ISLAND
Back Creek
Lollar Cove
MAXIMUM GROUND ELEVATION 21 FEET
DATUM IS MEAN SEA LEVEL
FOR SALE BY U. S. GEOLOGICAL SURVEY, WASHINGTON 25, D. C.
MONIE, MD.
1942

Appendix G-54


SUBMERSED AQUATIC VEGETATION DISTRIBUTION – 1978
UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
KEDGES STRAITS QUADRANGLE
MARYLAND
7.5 MINUTE SERIES ORTHOPHOTOMAP (TOPOGRAPHIC)
Holland Island
Zp,Rm,Zm
Rm,Zm
Rm,Zp
HOLLAND STRAITS
CHESAPEAKE BAY
KEDGES STRAITS
SOUTH MARSH ISLAND
TANGIER SOUND
SMITH ISLAND
MARTIN NATIONAL WILDLIFE REFUGE
Rm
KEDGES STRAITS, MD.
SCALE 1:24000

Appendix G-55

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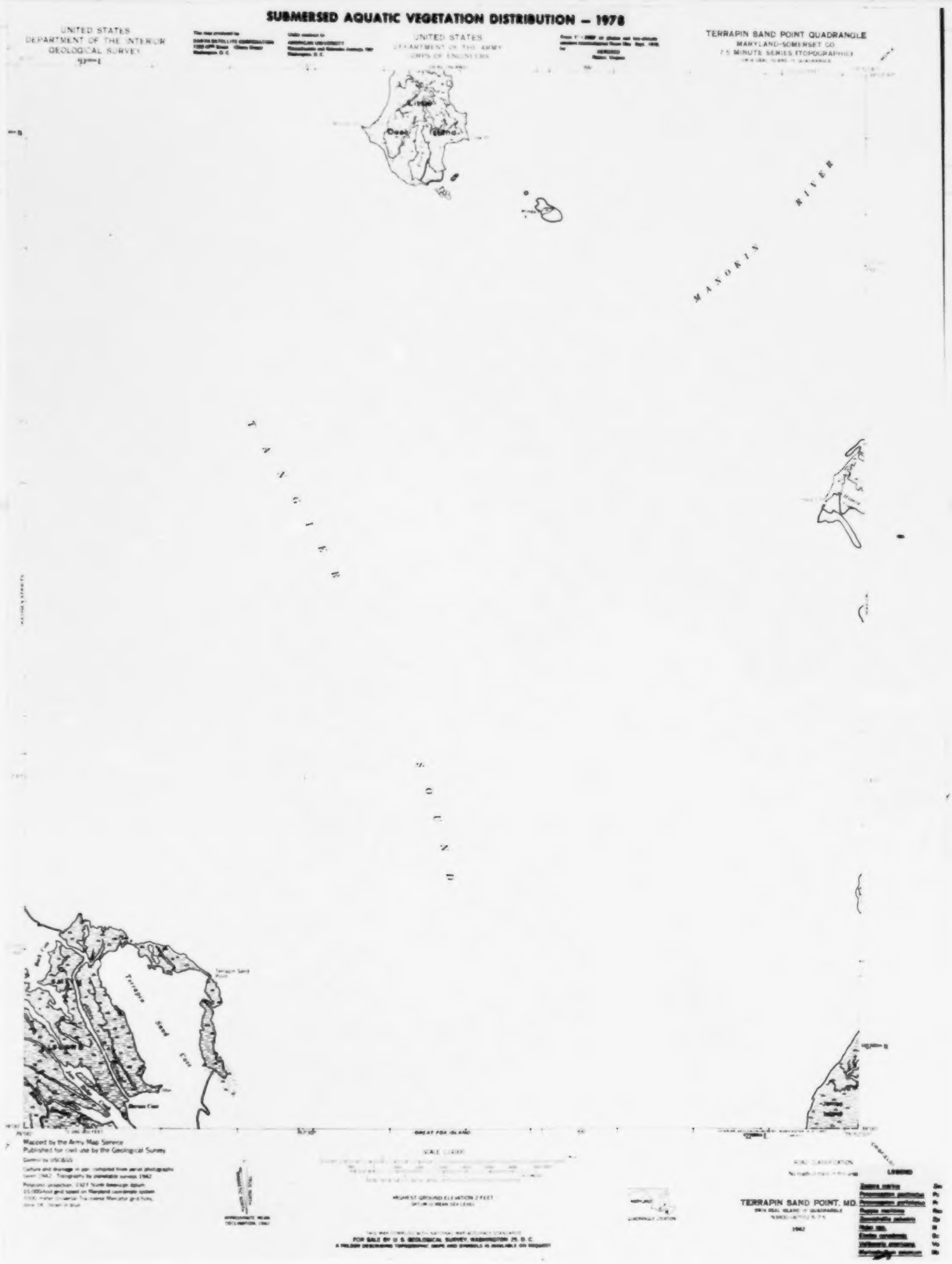
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GREAT FOX ISLAND
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HIGHEST GROUND ELEVATION 2 FEET
ROAD CLASSIFICATION
TERRAPIN SAND POINT, MD.
1942
LEGEND
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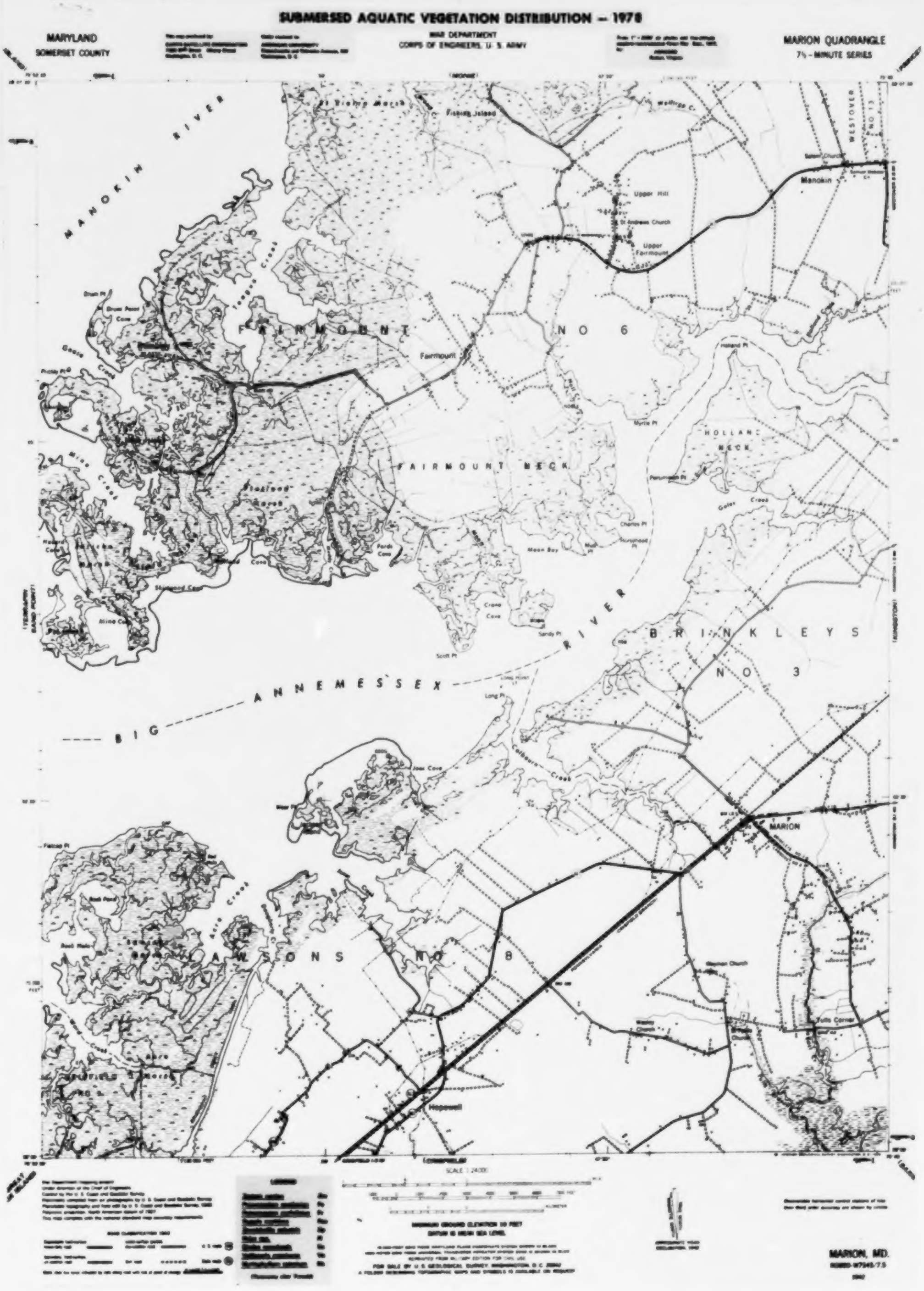
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Moon Bay
Charles Pt
Crane Cove
Scott Pt
Sandy Pt
BRINKLEYS NO 3
BIG ANNEMESSEX RIVER
Long Pt
MARION
LAWSONS NO 8
Hopewell
WESTOVER NO 13
SCALE 1:24 000
MARION, MD.
1942

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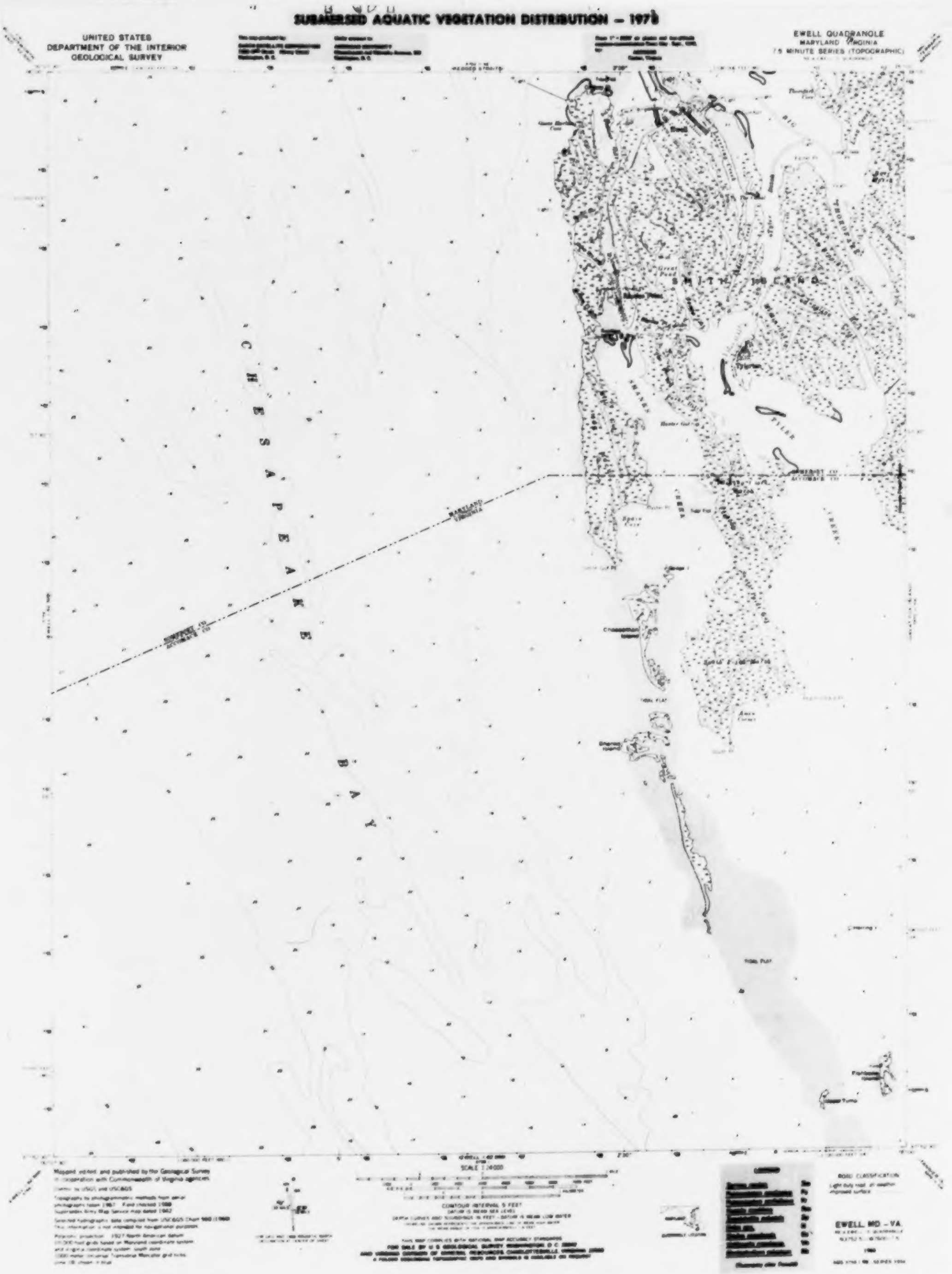
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SMITH ISLAND
MARYLAND
VIRGINIA
TIDAL FLAT
SCALE 1:24000
CONTOUR INTERVAL 5 FEET
EWELL, MD - VA.

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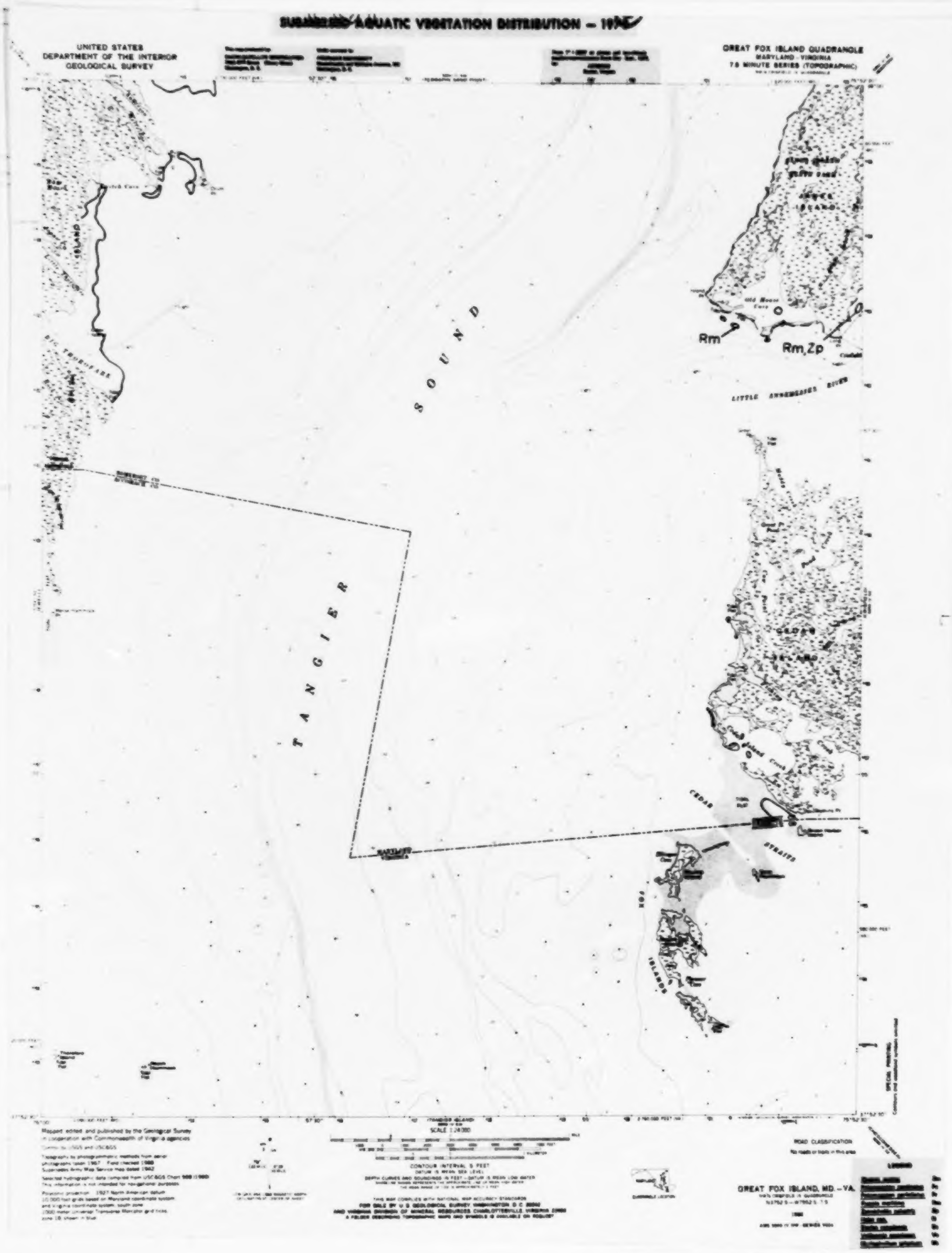
115

74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Rm,Zp
LITTLE ANNEMESSEX RIVER
SOUND
TANGIER
CEDAR ISLAND
CEDAR STRAITS
MARYLAND
VIRGINIA
SCALE 1:24000
CONTOUR INTERVAL 5 FEET
DATUM IS MEAN SEA LEVEL
Mapped, edited and published by the Geological Survey
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ROAD CLASSIFICATION
No roads or trails in this area
GREAT FOX ISLAND, MD.–VA.
LEGEND

Appendix G-59

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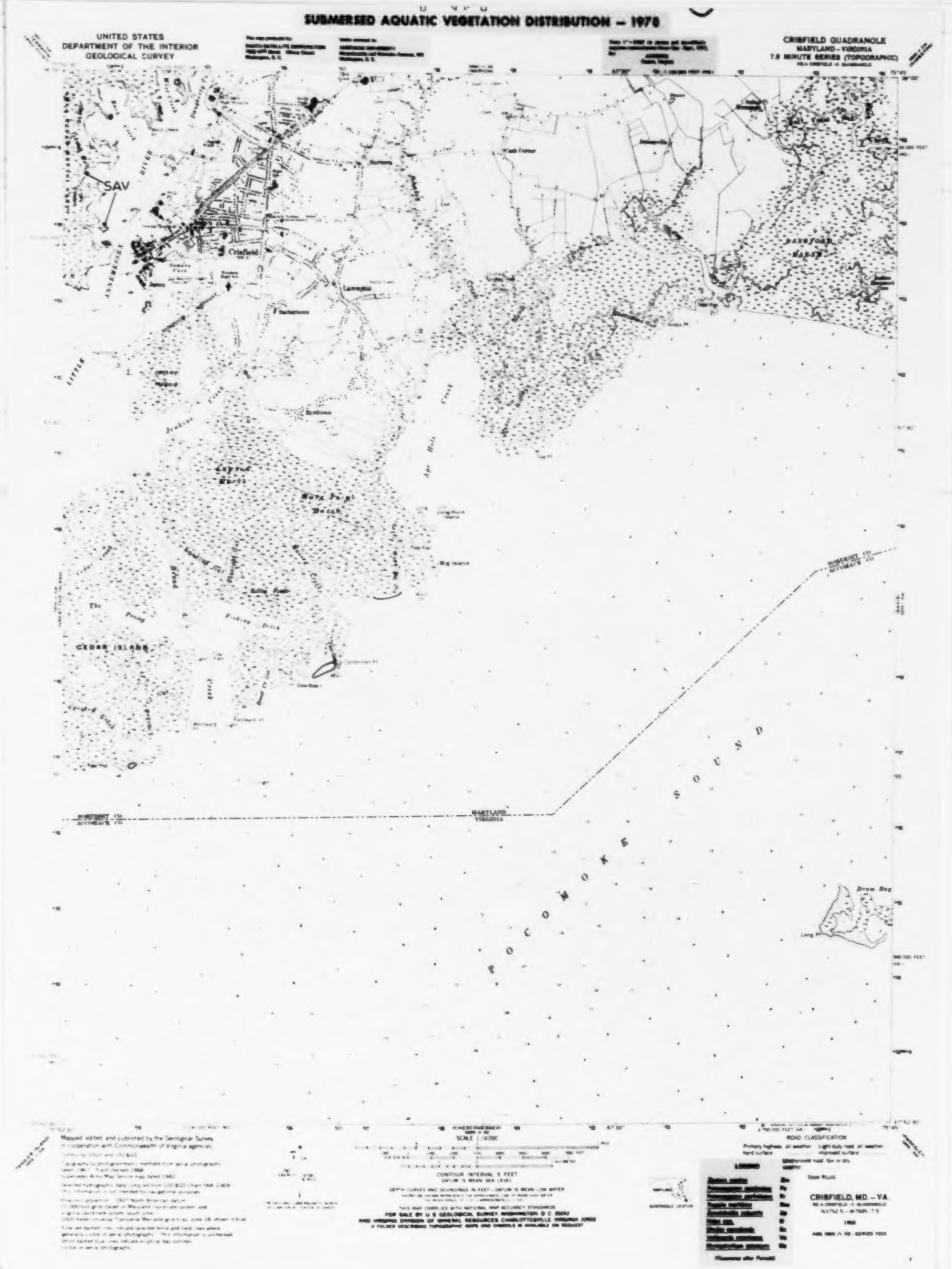
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Drum Bay
Mapped, edited, and published by the Geological Survey
in cooperation with Commonwealth of Virginia agencies
SCALE 1:24000
CONTOUR INTERVAL 5 FEET
DATUM IS MEAN SEA LEVEL
DEPTH CURVES AND SOUNDINGS IN FEET—DATUM IS MEAN LOW WATER
THIS MAP COMPLIES WITH NATIONAL MAP ACCURACY STANDARDS
FOR SALE BY U S GEOLOGICAL SURVEY, WASHINGTON, D C 20242
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A FOLDER DESCRIBING TOPOGRAPHIC MAPS AND SYMBOLS IS AVAILABLE ON REQUEST
ROAD CLASSIFICATION
LEGEND
CRISFIELD, MD.–VA.

Appendix G-60

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